Smart Guide 1

Synthetic Sports Surfaces

Surfaces and Standards.

smarter synthetic solutions

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Acknowledgements

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Without their support, we would not be able to achieve our goal to enhance the knowledge of the industry on synthetic sports turf fields. We would also like to thank our colleagues, clients and organisations that we have completed work for in the sports industry. It is your appetite for change and progress that makes our job so rewarding.

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Disclaimer

Smart Connection Consultancy do not accept any liability for the accuracy of the information provided. All material and information that is provided from the third parties is done so in good faith to assist organisations understand the key issues around synthetic sports surfaces. We will continually update the Smart Guide to attempt to keep the industry updated.

About the Smart Guide to Synthetic Sports Surfaces

Smart Connection Consultancy is committed to sharing knowledge and learnings with the industry and has produced a number of volumes of the Smart Guide to Synthetic Sports Surfaces which can be downloaded free of charge from our website www.smartconnection.net.au

The volumes of the Smart Guide to Synthetic Sports Surfaces include:

- Volume 1: Surfaces and Standards (2021)
- Volume 2: Football Turf – Synthetic and Hybrid Technology (2021)
- Volume 3: Environmental and Sustainability Considerations (2021)
- Volume 4: Challenges, Perceptions and Reality (2021)
- Volume 5: Maintenance of Synthetic Long Pile Turf (2021)
- Volume 6: Multi-Sports Areas for Schools and Local Communities (2021)
- Volume 7: Minimising the Impact of Microplastics on the Environment (2021)

About the Author

Martin Sheppard, Managing Director, Smart Connection Consultancy

Martin has worked in the sport and active recreation industry for 40 years, managing a diverse portfolio of facilities including leisure centres, sports facilities, parks and open spaces, athletic tracks, synthetic sports fields, golf courses and a specialist sports and leisure consultancy practice.

He clearly understands strategic and the political environment of sport, whilst also providing tactical and innovative solutions. Martin is an international speaker whose expertise is recognised for aligning synthetic surfaces and facility development, with player pathways, supply and demand forecasting and participation growth strategies.

Martin is the Technical Consultant for Australia's leading Football codes including:

Suite 40, 204-218 Dryburgh Street

North Melbourne, Victoria, Australia 3051

t: +61 (0)3 9421 0133

e: martins@smartconnection.net.au

w: www.smartconnection.net.au

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Welcome and Purpose

The popularity of synthetic sports surfaces used by many sports, local governments and within the education sector in Australia has significantly grown in the last two decades to complement the sports natural turf fields. This enables the local community to participate in sport when the demand on natural fields cannot be accommodated.

The key sports codes in Australia have all embraced synthetic sports surface technology for their community clubs and some for their elite players. Their aim is simply to provide more opportunities for communities to play sport and appreciate that the synthetic sports surfaces is one way of creating significant additional playing hours in many areas where fields are in short demand.

The aim of this Smart Guide to Synthetic Sports Surfaces Volume 1: Surfaces and Standards is to provide guidance to organisations who are interested in understanding the options available to them for adopting synthetic sports surface technology, the standards for the sport and an indicative costing appreciation. It also provides an overview of the key sports codes, the required global standards and their approaches in Australia. It is anticipated that this should guide community groups in understanding the benefits and use of such technology.

Smart Connection Consultancy is passionate about working with organisations that are keen to encourage their community to be more active. Sport is one of the vehicles to achieve this and provides many physical, community and health benefits.

Smart Connection Consultancy has embraced the use of sports surface technology, whether that be natural, hybrid, synthetic or alternative sports surfaces to complement natural fields as a vehicle to promote and provide the community with opportunities to be more active more often.

Photo 1: Football (Soccer) Gosnells LGA, WA (source: ABS Sports Surfaces)

Photo 2: Multi-sport – Heathdale Christian College, Vic (source: Grassports Australia)

Photo 3: Multi-sports facility Ilim College, Vic (source: Grassports Australia)

Photo 4: Football, AFL and Cricket - St Kevin's College, Vic (source: Tuff Turf)

1. Sport Surface Options

1.1. Introduction

1.1.1. Growing Embracement of Synthetic Surface Technology

The growth of the Australian population over the past 21 years has seen an increase of over six million[1] (33%) from approximately 18 million to 24 million people. The expected population in the next 15+ years will rise to be over 31 million[2] (approx. 40% increase) and this will seriously impact on sports field provision and accessibility in many cities around Australia.

This demand will continue to place significant pressure on sports field infrastructure around key cities in Australia where demands for additional playing fields and additional hours per field continue to exceed the hours available for natural surfaces.

With that pressure on natural turf the fields are having to cope with more people, many playing modified and adapted versions of the sport, such as 5-a-side Football, AFL 9's, Touch Rugby, Viva Rugby, Hockey 5's to name but a few, resulting in a greater intensity of use than normal, with a football field usually used by 22 players frequently having to cope with 80+ users.

Photo 5: Multi-sport field designed for local parks to encourage play and recreation (Source: Team Sports)

1.1.2. The Challenges

All levels of government are encouraging children to play sport and recreate resulting in increasing daytime and weekend usage of sports facilities. Not forgetting the changes in weather patterns, with some states having more rain or greater droughts then they can remember, both of which are becoming more common. So how can natural turf really cope with the demand? The challenge for local government, education and sport is how their natural surfaces can cope with the additional intensity of recreation, training and matches. So, what are the options informing the decision-making process?

To make the decision on the type of surface that will be needed for a specific project there are a number of variables that need to be considered.

In essence, a surface should be considered not only by itself but as an element of the network it is part of, whether that be by sport or indeed by geographical region as many times re-working of the programming of fields can allow teams to play on non-home fields to rest them during the week so that matches can be played at weekends.

The most common decision-making points are based around:

- **Playing capacity**

What are the needs of the community to satisfy demand? What type of synthetic or hybrid surface together with the current facilities should be planned for the future to meet the growing demand?

- **Standards of play**

Is there a specific standard for the level of sport that is linked to the International Sports Federation or National Sports Organisation that the sport or clients wishes to have in place? (e.g. Hockey, Athletics and Netball tend not to play on natural grass).

- **Economic considerations**

What can be afforded at the capital installation time and for the recurring budget costs of maintenance and replacement costs? There is also a need to consider the revenue strategy opportunities to offset the budget costs.

- **Technical consideration**

What are the technical aspects that will need to be considered to achieve the previous three decision making points?

[1] ABS, Australian Demographic Statistics (cat. no. 3101.0), data extracted 21 December 2016 http://abs.gov.au/ausstats/abs%40.nsf/94713ad445ff1425ca25682000192af2/1647509ef7e25faaca2568a900154b63?OpenDocument

[2] ABS, http://www.abs.gov.au/AUSSTATS/abs@.nsf/mf/3222.0

- **Strategic alignment**

How does the suggested decision align with key strategic and policies of the purchaser and the key stakeholders?

- **Environmental benefits**

What are the benefits and implications for the environment of the various options to assist with the decision-making point, from Green Engineering best practice, water sustainability, to installation methods, management sustainability and impact on the environmental footprint?

All of these options have been built into this Study and the decision-making assessment process being proposed.

1.2. Overview and Context

1.2.1. History and Evolution

The popularity of synthetic surface technology in sport has been embraced by both community and elite levels over the past five decades, with different reasons for their use and introduction.

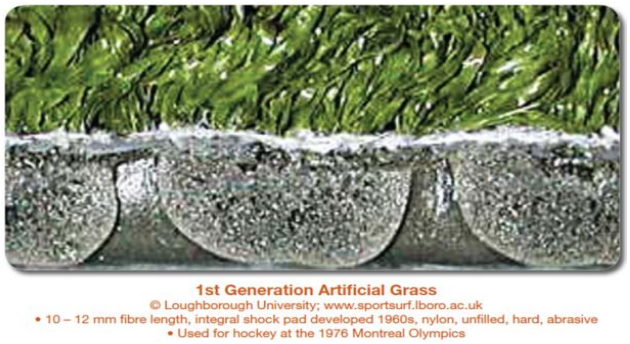


Photo 6: First Generation Artificial Grass

The technology has evolved significantly from the first generation carpet that was developed by Monsanto for the Ford Foundation at Moses Brown School, Providence, Rhode Island in 1964. The first major commercial mainstream surface was used in 1966 at the Houston Astrodome in Texas. Key milestones, for their usage over the past 50 years include:

1960's

First Generation Turf (1964). A knitted nylon carpet with a foam backing was used for indoor Gridiron but lacked the sophistication of the present systems.

The first synthetic athletics track was used at the Mexico Olympic Games (1968) and has been the surface of choice since for track and field athletics.

1970's

The use of the 1st generation nylon carpets continued in American stadiums where light was too poor for natural grass growth. Although the "turf look" was a positive use of technology for the TV and spectators it wasn't so good for the athletes, it didn't provide an accurate reflection of natural playing surfaces. The coarseness of the nylon resulted in inconsistent playing conditions and injuries caused the majority of football and baseball surfaces to be replaced with natural grass again.

One sport that did prosper with the use of synthetic turf during this time was hockey. When the synthetic grass was wet the ball played far faster and the game was far more enjoyable. The sport embraced the technology and the first international hockey game using artificial turf was played at McGill University, Canada in 1975. The following year it was showcased at the Montreal Olympics and has been used ever since.

At the turn of the decade there were two schools of thought relating to the use of synthetic technology:

- Performance needs to mirror natural grass – with the use of the 1st generation surfaces needing to perform more closely to natural grass; and
- Performance enhanced surfaces – with IAAF (athletics) choosing the rubber tracks and FIH (hockey) choosing technology to improve the speed of the game and the performance compared to natural surfaces.

These opposing viewpoints can still be seen 40 years on when we compare how sports have embraced the use of technology.

1980's

The 2nd generation synthetic turf was developed to look and feel like grass, with the soil replaced with sand and the blades of grass replaced with 20-35mm tightly packed polypropylene yarn. This was softer than the nylon on players' skin, but when combined with sand, created some challenges:

- Playability – the sand infill and yarn combination didn't let the large ball used for football (soccer) have the same playing characteristics as on natural turf. It bounced unpredictably and the roll was far faster; and
- Safety – the friction on skin was significant and caused 'skin burns' which then developed into wounds if not treated.

The durability for community football pitches (5-a-side facilities) was excellent and allowed many more people to play the game. As 5-a-side in the United Kingdom has

larger participation rates than 11-a-side, this was a positive outcome.

Four United Kingdom professional football clubs invested in synthetic turf in the 1980's, including Queens Park Rangers (Loftus Road), Luton Town (Kenilworth Road) and Oldham Athletic (Boundary Park).

Hockey continued to embrace the technology with most major competitions being played on synthetic watered turf.

Photo 7: 2nd Generation Synthetic Turf (source: Cranfield University www.cranfield.ac.uk)

At the end of the decade the European governing body for soccer EUFA ruled that professional level games should not be played on synthetic turf.

1990's

The major manufacturers of synthetic turf understood the benefits to community and elite sport that the technology could offer but could not convince the world sports' governing bodies by themselves.

The world governing body with the most interest in the 1990's was FIFA for football (soccer), and they made it clear that the playability and performance needed to reflect the standards of natural turf.

The 3rd generation (3G) synthetic turf was born using a different and more holistic approach in Europe and America. After much research, the end of the 1990's saw a new generation turf, using a softer yarn, polyethylene, with rubber granules and sand now used more as ballast rather than the key component of the infill. This allowed the surface to take a normal stud/cleat, which convinced the rugby codes, AFL and cricket to try this 3rd generation, joining football and gridiron.

2000's

The decade saw the defining period for the use and adoption of synthetic technology, with many sports embracing the benefits. Many of the sport's world governing bodies:

- Developed standards for elite and/or community pitch performance, including football (FIFA), rugby union (World Rugby), hockey (FIH), bowls (WB), athletics (IAAF), Australian rules football (AFL) and tennis (ITF);
- Introduced an accreditation scheme for suppliers and/or products;
- Changed the rules of the game so that players could compete on the surfaces including: Football (FIFA), Rugby Union (World Rugby), Bowls and Australian Rules (AFL);
- Ensured that pitches were tested regularly to meet the standards; and
- Promoted the use of the technology to grow participation in the game.

2010's

The last decade saw systems become more sophisticated and the research has been embraced around the science of the issues affecting play, including:

- Multi-sport – so that more than a single code including the football codes of soccer, union, league, Aussie rules could all be played on a single surface
- Durability – the technology has developed to allow more hours and intensity of usage
- Environmental considerations – removal of heavy metals; increased usage of virgin rubber and organic material and attempting to address the heat issue

2020's

This decade will see the industry continue to address the environmental challenges such as microplastics, heat, water usage and recycling. The key evolutions of the sector may include:

- ***Design*** – to allow for the growing trend of multi-sport on full size fields as well as mini-fields
- ***Environmental considerations*** – addressing community concerns about the safety, health and environmental challenges that the industry face
- ***Management opportunities*** – the design and planning will reflect how the fields will be managed, including embracing technology to monitor usage, increase programming, shared by multiple clubs and organisations
- ***Cost Reduction Strategy*** – the Whole of Life costs will be embraced in the cost to use the facility
- ***Possible 4th generation*** – with limited infill to reduce the environmental impact of the infill
- ***Recycling End of Life*** – the whole system needs to be able to be recycled 100% before they are installed now. This should include the carpet backing (primary and secondary) and infill

Photo 8: Multi-sport field in Sutherland Shire (Kareela Oval, NSW)

1.2.2. Synthetic Sports Surfaces Benefits and Challenges

The main reasons given for installing a synthetic surface for sport and recreational use are:

- **Climatic:** Under drought and water restrictions or excessive rain conditions, it can be difficult to maintain a safe and suitable natural grass surface. Synthetic sports surfaces in general are not affected by the reduced or increased rainfall;
- **Usage:** There is a limit to the hours natural turf can be used before there is a significant impact on surface condition. A high-quality natural turf surface may only withstand use for up to 20 hours[3] per week before it starts to deteriorate. Synthetic surfaces can sustain significantly higher use than natural grass with 60 hours[4] plus per week as an acceptable expectation
- **Maintenance:** Maintaining a turf surface can be time consuming, expensive and generally requires a qualified person to do it. Synthetic surfaces require lower ongoing maintenance than a natural turf surface
- **Consistency and quality of play:** Synthetic surfaces provide a consistent and safe surface all year around for all sports to play on, improving the quality of performance for each sport compared with natural playing surfaces
- **Mandated:** some sport's governing bodies insist that if a particular level of game is played, it has to be on a particular quality of synthetic surface (e.g. Athletics and hockey fields etc.).

History of Synthetic Sports Turf in Australia

Australia has been embracing synthetic sports turf technology since the 1970's and in some areas, it is seen as the norm now, with both the education sector and key sports such as cricket, hockey and athletics as well as the football codes now starting to embrace it.

Over the last twenty years the key milestones where new technology has been introduced and embraced can be summarised in Table 1.

Photo 9: Australia's first woven carpet full sized field of play (source: TigerTurf)

Negative Perceptions

There is a significant lack of understanding about the technology, with some community groups expressing concern around how the technology is made, managed and/or how it integrates into the local environment. The major concerns include:

- Environmental integration – whether there is a negative impact on the environment (e.g. leaching)
- Player comfort and safety – for injuries, overall safety and impact between the surface and the player

The Smart Guide to Synthetic Surfaces: Volume 4 Challenges, Perception and Reality provides insights into these concerns.

[3] As quoted by Keith McAuliffe, Sports Turf Institute in conference 2011 before deterioration of turf on average in Australia

[4] FIFA consultant at NSSCE Conference in Sydney quoted 80 hours per week as their expectations in Europe

Table 1: History of synthetic sports surfaces in Australia

Type	Year	State	Comments
Cricket Wicket (outdoor)	1983 2010	NSW NSW	Supergrass product installed First movable cricket wicket for an AFL/CA field and outfield installed at Northbridge oval
Indoor Cricket	1970's	WA	Dennis Lillee wicket
Soccer (not certified)	1998 2005	ACT Vic	Astroturf USA, 3rd generation (sand/rubber) at the Australian Institute of Sport Victorian Soccer Stadium installed three football turf fields (Darebin) with a FieldTurf product installed by Tiger Turf
AFL/Cricket	2008 2010	Aus Vic	AFL published community field guidelines, with Cricket Australia for Australian Rules Football fields TEAM Sports, round sand infill on shockpad, for Melbourne City Council at JJ Holland Park
Rugby Union	2000 2014	Gold Coast, NSW	TEAM Sports, Runaway Bay Super Sports Centre, 3rd generation (sand/rubber) – not accredited First IRB Regulation 22 Rugby Field, at Blackman Park Lane Cove
Hockey (water base)	1987	NSW	Supergrass, Homebush State Sports Centre using 15mm straight yarn
Hockey (sand-base)	1987	ACT	Balsam Pacific, Lyneham Hockey Centre, 34mm sand filled
Lawn bowls (not carpet)	1986/87	NSW	Supergrass, City Bowls Club, Sydney, 25mm sand filled
Tennis (rebound)	1982	NSW	Multi-use Netball etc.
Tennis (lawn type)	1978	NSW	Ampol Petroleum Co. imported first 19mm synthetic grass court and installed at Ingleside, Sydney
Tennis (Clay)	2001	Vic	Grass Manufacturers, first terra cotta coloured yarn with clay coloured sand
Grid Iron	2011	NSW	Team Sports, with permanent five yard markings and temporary blue paint sidelines and goal lines
Multi-sport (certified)	2016	Moore Park, NSW	Australia's first multi-sport certified field at Moore Park, Sydney, allowing Football, 11-a-side, 5-a-side (FIFA Quality Mark), Rugby Union (Regulation 22 standard) and Rugby League (Community Standard)
Rugby League	2017	NSW	Australia's first Rugby League field installed by Blacktown City Council at Kellyville Ridge

1.3. Sports Adoption and Standards

1.3.1. Introduction and Context

Many global sports have embraced the use of synthetic sports surface technology for their sports and have developed standards for the sport for fields/surfaces that could be used for community sport and stadium/elite sport. A summary is shown in Table 2.

The performance standards for each sport identify the safety, performance, playability, technical and durability standards that a synthetic sports system needs to achieve. This demonstrates and provides confidence to users that the field will play with similar 'playing characteristics' to a quality natural turf field. Some sports such that have an engineered base surface such as hockey and hard surfaces for tennis, netball and athletics do not attempt to replicate grass but are designed to enhance the surface playing characterises that grass gives. The emphasis of these standards is focused on the interaction between the surface, players and the ball, reflecting the playing characteristics for each sport.

It is critical for all sports that when a purchaser is considering procuring a synthetic sports system that the installation is to the appropriate International Federation sports required standards, also detailed below.

Table 2: Performance standards of synthetic playing surfaces for a range of sports

Sport	Elite/Stadium Level	Community Level
Athletics	IAAF 1	IAAF 2
Hockey	Global and Global Elite	National and Multi-sport
Football (Soccer)	Quality Pro	Quality
Rugby Union	Regulation 22	Regulation 22
Rugby League	Stadia	Community
Gridiron	None	None
Tennis	ITF 2	ITF 1
AFL/Cricket Aust	N/A	Community

1.3.2. Laboratory and Field Testing

Most sports have a process that needs to be followed before a field is certified or accredited against the sports performance standards. This process, which varies with each sport, generally has the following five steps:

Step 1: Manufacturer Agreement
The manufacturer needs to demonstrate to the International Federation of the sport that they have the credentials to produce a field to the correct standards and can provide quality assurance - either under a license (entry level) or preferred provider/producer status (higher levels of quality assurance needed).

Step 2: Laboratory Test
An accredited laboratory identified by the sport's governing body tests a sample product to ensure it performs according to their 'Testing Handbook/Guide'. If the product passes the laboratory tests it can then be used for installation.

Step 3: Pitch/Field Installation
The manufacturer, or one of their licensees, will install the product which has been laboratory tested into the field. Once installed and settled (normally around 40 hours/ up to 1 week) it can be tested.

Step 4: Insitu-Field Test
The independent and accredited laboratory on behalf of the sports peak body (e.g. AFL; FIFA; World Rugby; FIH etc.) will test the field against each performance criteria and ensure that the field installed matches the system characteristics that the laboratory test 'passed previously'.

Step 5: Certification
The world governing body of the sport will issue a certificate for the playing field/court and this will be relevant for the duration of that certificate, which can vary from: one year (FIFA Quality PRO and NRL Stadium standard); two years (WR, AFL); Three years (FIFA Quality); and up to 10 years (Tennis Court Recognition Program).

1.3.3. The Importance of Testing

The importance of having the field tested is linked to 'Achieving Performance' and 'Risk Mitigation'. The key sports have considered both issues. The AFL and Cricket Australia have partnered with JLT Insurance to ensure that only fields that are tested can be used for competition games. In Rugby Union, Regulation 22 states that the field should be re-tested every two years and the local union (i.e. Rugby Australia) should ensure that the member unions and World Rugby are insured against claims.

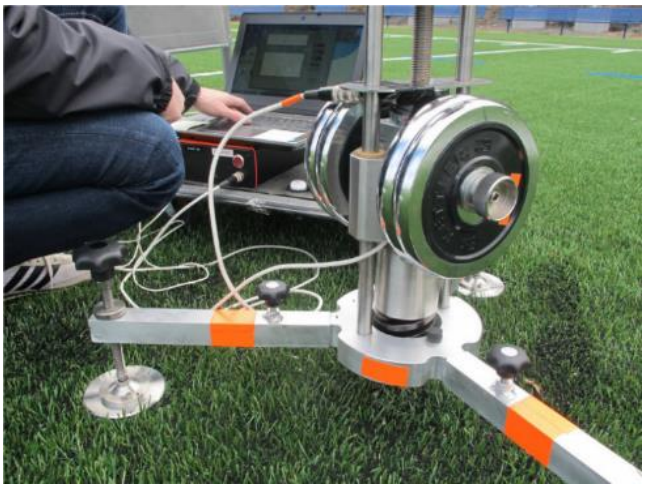


Photo 10: Labosport testing a 3G field

The benefits of testing:

- Peace of mind that it meets the required standards;
- The durability of the product should last the planned life expectancy;
- There will be reduced risks associated with the system;
- The maintenance is being carried out adequately; and
- The ongoing performance characteristics are being achieved.

2. Sports Specific Standards

2.1. Athletics

Athletics was an early adopter of synthetic technology and in 1968 athletics installed its first synthetic athletics track for the Mexico Olympics. The times and performances were so impressive that the sport's governing body has never returned to natural surfaces, supporting the technology in order to continue to improve performances.

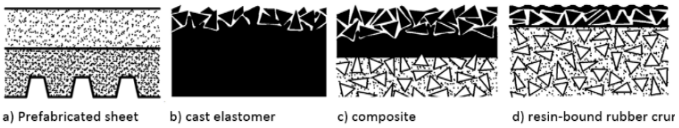


Figure 1: Synthetic surface types for athletics tracks

2.1.1. Types of System

There currently exists a range of synthetic surface systems for athletics facilities approved for use by World Athletics.

In Australia, the most commonly used systems are:

- In-situ resin bound rubber crumb system ('structural spray') system
- In-situ composite ('sandwich') system
- In-situ cast elastomer ('full PUR') surface
- Prefabricated sheet synthetic surface

2.1.2. Athletics Track Standards

The world governing body for athletics is World Athletics and they have a certification system for the tracks which, similar to other sports have a product testing certification and a facility test, in-situ at the venue.

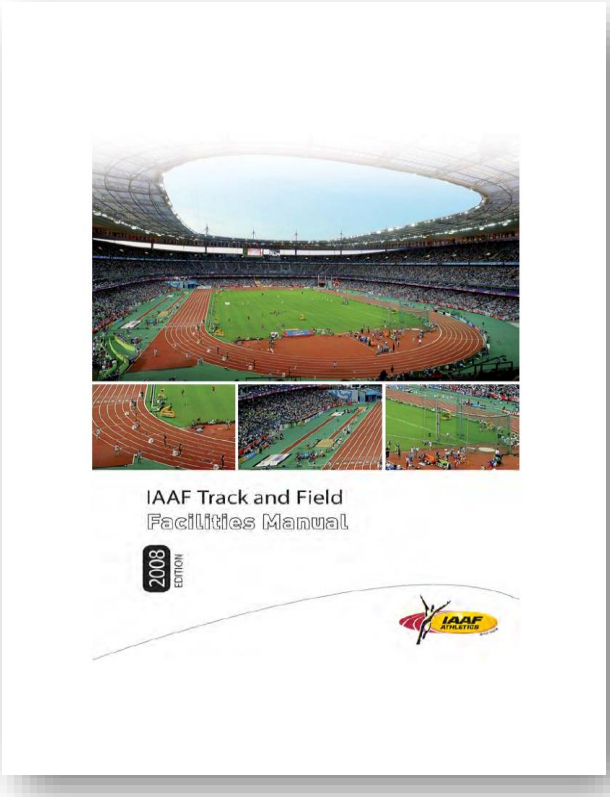
For competition, has two standards of track: elite and community.

The facility manual can be sourced from https://www.worldathletics.org/about-iaaf/documents/technical-information

Athletics Australia have a number of guides available including:

- **General Facility Brief** - This outline brief may be used as a starting point for the group designated to advise consultants on the design of new athletics facilities. The facility envisaged here is a major facility with an extensive grandstand. However, it can be adapted for lesser facilities.
- **Recommended Procedures for Operating and Maintaining Athletics Facilities** - A synthetic surfaced athletic facility is a major investment. This paper covers recommended procedures for operating and maintaining athletic facilities.

(Editor's note: these are both 2005 documentation and need to be updated).



2.1.3. Expected Life Cycle

The lifecycle of an athletics track surface is heavily dependent on the following:

- Level of use
- Level of maintenance
- Standard of initial construction
- Environmental factors (e.g. UV exposure)

The following table provides an overview of the expected life cycle for an acrylic surface:

Year	Activity
0	Pavement constructed Athletics track surface system installed
3-5	Repair high-wear areas
7	End of warranty period
10 – 15	Grind down to the pavement profile and apply 'wearing surface'
20+	Full resurface

Costs

Depending on exchange rates, the following table outlines typical costs for the above systems.

Athletics Track System	Rate (/m^2)
In-situ Resin Bound Rubber Crumb System	$40 – $45
In-situ Composite System	$65 – $70
In-situ Cast Elastomer System	$90 – $95
Prefabricated Sheet Synthetic Surface	$110 – $120

2.2. Australian Rules Football

As custodian of the game, the AFL has recognised the need to develop ways to increase the carrying capacity of their surfaces and protect them against weather extremes as more people wish to play their sport. This approach should assist in increased participation rates, reduce injuries and allow more people to play more often.

2.2.1. Type of System

In 2007 the AFL together with Cricket Australia, Sport and Recreation Victoria and Australia's largest public-sector insurance company, JLT Trustees, collaborated with researchers[5] to develop a set of guidelines for community use of synthetic surfaces on which to play Australian Rules Football and Cricket. As the majority of Australian Rules Football grounds are also cricket grounds, it was important for any standards to ensure it was suitable for play by both sports.

The research explored the playing characteristics of quality natural turf and developed the performance criteria that the surface needs to be judged against, including the mechanical properties of the surface, ball and player interactions with the surface, using internationally recognised testing equipment and procedures.

Photo 11: AFL/Cricket and Football at ELS Hall Field, Ryde City Council NSW (source: Turf One)

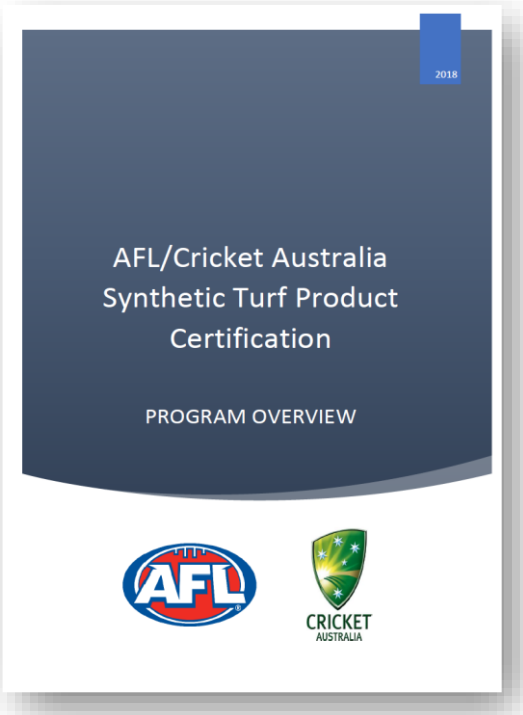
2.2.2. Australian Rules Standards

The results of the study enabled a development of standards for Artificial Turf for AFL and Cricket[6]. Since this time numerous pitches have been tested, a number of others have been installed where cricket is played on football (soccer pitches), and the same standards are used. In 2018 the standards were updated with a user-friendly handbook[7]. The handbook 'fine-tuned' the standards, in light of what has been learnt on synthetic turf since 2013, the main changes are to the benefit of the game.

[5] Ballarat University (now Federation University)
[6] Development Standards for the use or Artificial Turf for Australian Football and Cricket (2008 DIW May; L. Otago; N. Saunders; E. Schwarz: University of Ballarat School of Human Movement and Sport Science

[7] Australian Football League and Cricket Australia Handbook of Testing for Synthetic Turf (Sep 2013 www.aflcommunity.com.au)

The new standard[8] also allows for the product and not just the manufacturer to be accredited, which is a very positive step forward in Australia as it provides greater competition in the marketplace, similar to today's global approach.



Expected Life Cycle

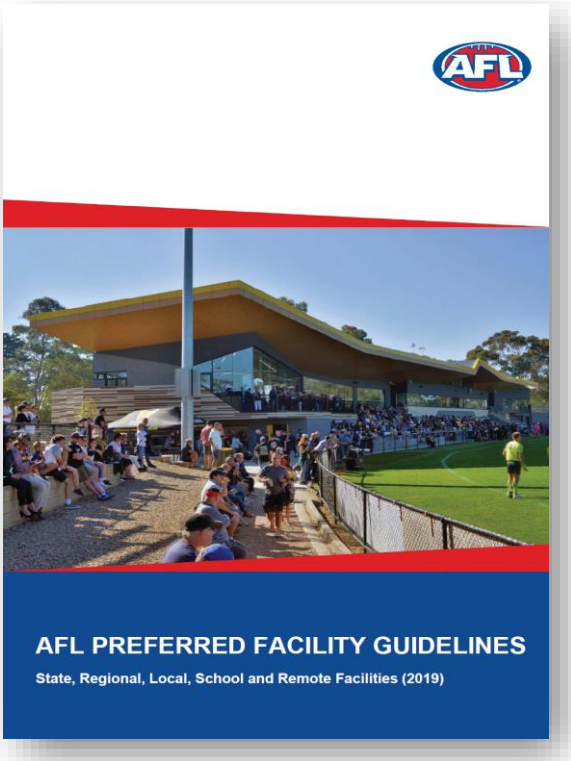
The lifecycle of an Aussie Rules field surface is heavily dependent on the following:

- Level of use
- Level of maintenance
- Standard of initial construction
- Environmental factors (e.g. UV exposure)

The following table provides an overview of the expected life cycle for an acrylic surface:

Year	Activity
0	Pavement constructed AFL/Cricket surface system installed
3-5 years	Repair high-wear areas
8-10 & 16-20 & 24-30 years	Replace carpet and infill, renovation to civil pavement may be needed Shockpad will probably need to be replaced between 24 and 30 years

[8] http://www.aflcommunityclub.com.au/fileadmin/user_upload/Manage_Your_Club/Facilities/2E_AFL_CA_Synthetic_Turf_Product_Certification_2018_Overview_f__AFL_CA_Synthetic_Turf_Certification_.pdf



2.2.3. Costs

The estimated cost for a typical Aussie Rules field (17,500m^2) would be in the region of $2.6-$3.0 million. The annual maintenance costs associated would be approximately $35,000. Replacement expectation based on 50 hours per week on medium intensity would be approximately 10 years.

2.3. Cricket

Regarding cricket, many councils have used synthetic wickets for years and this has historically been covered by soil during the winter months. This often causes safety concerns and reduces the consistency of play where the soil is located.

According to Cricket Australia's guidance[9], the wicket should be 25m-28m long and 2.4m to 2.8m wide, and the turf should be between 9mm and 11mm in length. This information can be found in their AFL Preferred Facilities Guidelines (2019)[10].

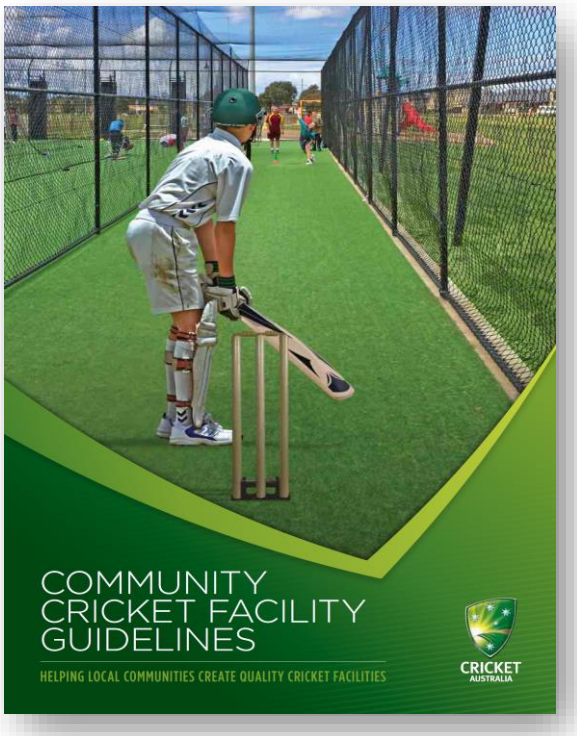
[9] Reference: Letter to LGA's in Victoria – dated 2010

[10] http://www.aflcommunityclub.com.au/fileadmin/user_upload/Manage_Your_Club/Facilities/AFL_Venue_Guidelines_2019_-_FINAL.pdf

2.3.1. Cricket Standards

Unfortunately, there are no standards for the cricket wicket in Australia to this date and the England and Wales Cricket Board have the only global standards which have not been embraced yet in Australia. So, depending upon the standard that the synthetic turf wicket is being used for this should be considered.

Cricket Australia have provided guidance on synthetic sports surfaces in their Community Cricket Facility Guidelines[11].



Expected Life Cycle

The expected life of a synthetic cricket wicket can be between 10 and 15 years depending upon usage and the type of winter protection applied (e.g. sand, natural turf, rubber or synthetic turf). The normal maintenance is at the start of summer which includes clearing the surface with a brush and/or high pressure hose followed by cutting the grass around the concrete wicket. It is important to secure the soil around the concrete wicket so that there is no trip hazards.

2.3.2. Costs

The estimated costs for a typical wicket with the concrete base is approximately $30,000.

2.4. Bowls

There are two main surface options (natural and synthetic) utilised for bowling greens. This guidance paper will provide an overview of the following surfaces:

- Natural turf
- Sand filled synthetic turf
- Woven carpet
- Needle punch carpet

Typically, state and international competition are played on high quality natural turf greens.

2.4.1. Standards and Requirements

The governing body for lawn bowls, World Bowls Ltd, provides standards for the minimum performance requirements of a lawn bowls surface, specifically in regard to the following:

- Green speed (the number of seconds taken by a bowl from the time of its delivery to the moment it comes to rest)
- Surface draw (the distance between trajectory of a rolling biased bowl and a straight line between start and end points)
- Surface evenness (measurement under a 3m straight edge)
- Design level (a comparison of theoretical and actual levels)
- Infiltration rate (the rate water enters the green surface)

World Bowls has developed an approval system for manufacturers/ suppliers of synthetic surfaces, utilising the above standards, to ensure surfaces are being sourced from reputable suppliers.

Natural Turf

Natural turf is the traditional surface type for a bowling green. The profile would typically comprise of a growing medium (e.g. sand or soil) and a warm or cool season turf. The turf species selected on a bowling green will typically depend on the local climate and availability at time of construction.

[11] https://www.community.cricket.com.au/clubs/facilities/facilities-guidelines

The advantages of this system are:

- Lower surface temperature on hot day compared with synthetic surfaces
- Easier to rectify damages/ uneven patches in localised areas

The disadvantages of this system are:

- Higher maintenance practices required
- Weather-dependent play
- Reduced hours of use
- Requires watering throughout the year to maintain turf coverage
- Longer construction phase due to the period required for turf establishment

Sand Filled / Dressed Synthetic Turf

A sand filled synthetic turf is a tufted synthetic carpet laid over a free draining engineered base and filled with sand to hold the synthetic fibres upright. A sand filled carpet pile height is typically 13-15mm with approximately 8mm of sand infill (i.e. 5-7mm pile height exposed) and historically has had an average of 20 tons of sand.

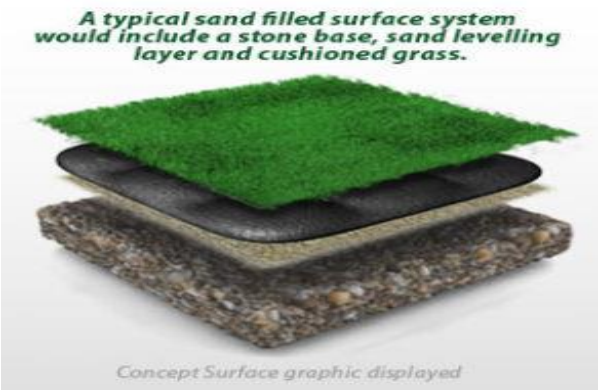


Figure 2: Sand Filled Carpet (source: ABS Sport Surfaces)

Currently many synthetic carpet suppliers are leaning to sand dressed carpets in preference to the sand filled. By embracing a denser fibre mix then the sand dressed only uses 12-14 tons of sand.

The advantages of the sand dressed system are:

- All weather surface
- Higher allowable hours of use compared with a natural turf green
- If systems consist of a shockpad, will provide comfort underfoot for users
- Can be bowled on in all four directions (i.e. ability to rotate wear patterns)

The disadvantages of this system are:

- Can scratch the woods
- Hotter surface temperature compared to a natural turf green
- Higher capital costs than natural turf

This is the most 'forgiving' system, but many traditional and competitive bowlers are not fans of this surface.

Woven Carpets

Woven carpet is a tensioned bowling green unfilled synthetic surface. Typically, a woven carpark has a height of around 4mm. The surface is tensioned to provide a consistent playing surface performance.

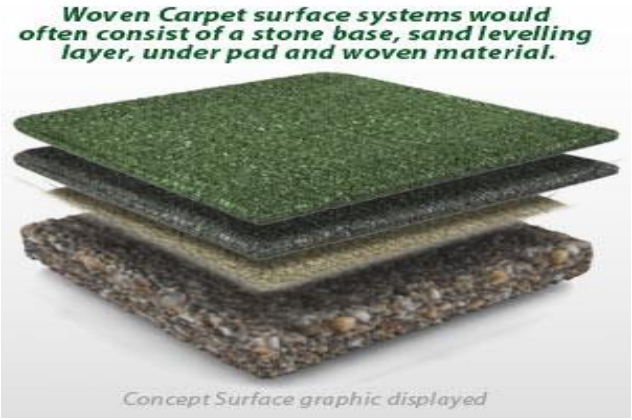


Figure 3: Woven Carpet Bowls Green (source: ABS Sport Surfaces)

The advantages of this system are:

- Consistent performance
- Higher allowable hours of use compared with a natural turf green

The disadvantages of this system are:

- Hotter surface temperature compared to a natural turf green
- Higher capital costs than natural turf
- Can generally only be used in two directions (perpendicular to seams)

Needle Punch Carpet

Needle punch carpets are manufactured by converting loose fibres into a non-woven fabric. The product is generally 6-9mm high overlying a 3-9mm underlay.

Needle Punch and Woven Carpets can be played in both directions and clubs are encouraged to do so, thus creating even wear across the surface. Most clubs prefer to play pennants across the seams, but local inhouse bowls and barefoot bowls can be played with the seams.

It is recommended that clubs use the seams as the centre therefore negating any controversy about bowls bouncing or running in the seam. Again, if the green is laid correctly, the seam should not affect the bowl trajectory.

The advantages of this system are:

- Higher allowable hours of use compared with a natural turf green
- All weather surfaces

The disadvantages of this system are:

- Hotter surface temperature compared to a natural turf green
- Higher capital costs than natural turf

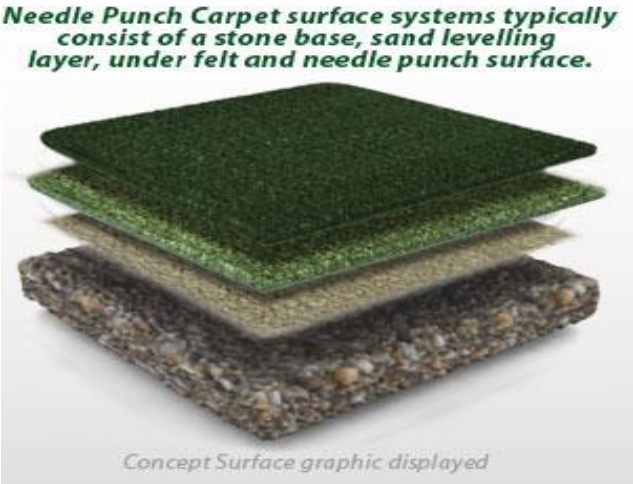


Figure 4: Needle Punch Carpet (source: ABS Sport Surfaces)

This system, although the more expensive is the most commonly adopted surface type by bowlers and is recognised as performing closest to natural grass.

2.4.2. Expected Life Cycle

The lifecycle of a synthetic surface is heavily dependent on the following:

- Level of use
- Level of maintenance
- Standard of initial construction
- Environmental factors (e.g. UV exposure)

The following table provides an overview of the expected life cycle for a Needle Punched carpet bowling green surface.

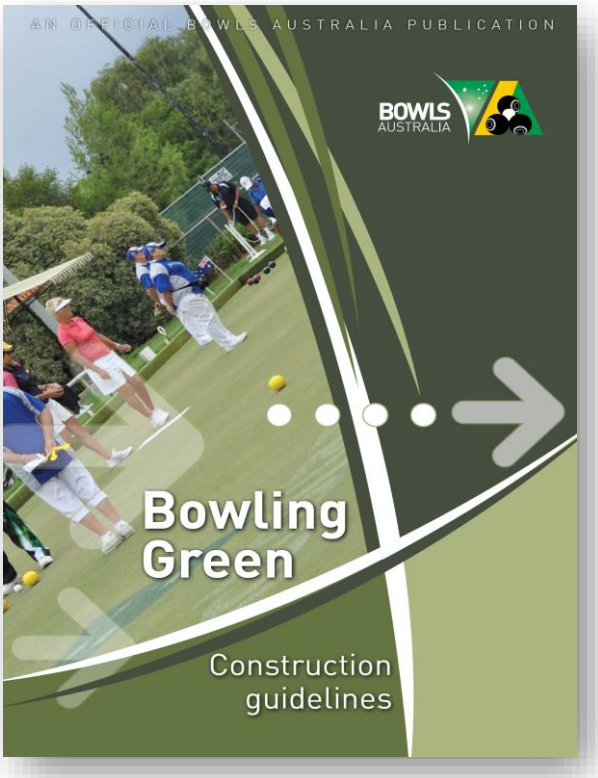
Year	Activity
0	Pavement constructed, and synthetic system installed
7	End of synthetic product warranty period (standard for all quality manufacturers)
10-12	Resurface of synthetic surface depending on maintenance and usage
10-12	Minor base rectifications
20+	Possible pavement reconstruction/ remedial works

Typically, a sand dressed green, subject to usage and maintenance would last approximately 12-14 years, compared to a Needle Punched Carpet which would be expected to last up to 12 years.

Cost of Installation

The cost of conversion for the two greens would expect to be approximately $535,425 with no investment allowed for lights fences etc. The report has allowed for a contingency and for project management (10%) costs.

Bowls Australia has developed a Bowling Greens Construction Guidelines[12]



[12] https://www.bowls.com.au/wp-content/uploads/2018/09/Bowling_Green_Construction_Guidelines.pdf

The difference in surface costs compared to a Needle Punch Carpet would be as follows:

- Woven $3,000 less per green
- Sand Dressed $15,000 less per green

1. Type of Green	Bowls	Life Expect	8 - 12 years
2. Size of area of field (40m wide x 40m long)			3,200
3. Green establishment direct costs	per m2 / lin. Metre		Total cost of field
Design			$4,000
Site establishment, documentation & project management			$20,000
Excavation works	$9		$28,800
Drainage	$10		$32,000
Pavement and associated concrete works	$42		$134,400
Plinth Construction	$5		$16,000
Surface Type - Needle punch carpet system	$77		$246,400
Surface Type - Sand Dressed carpet system			$216,400
Surface Type - Woven carpet system			$240,400
Needle Punched Carpet Green Sub total	$143		$481,600
Ancillary Costs			
Fencing			$0
Lighting			
Mainatenace Equipment / Training and Manuals			$5,150
Other			
Ancillary costs Sub-Total	$0		$5,150
Contingency & PM Costs	10%		$48,675.00
Total investment			$535,425

Maintenance Costs

The costs of maintenance will vary from club to club, depending on the usage, local landscape conditions (e.g. trees, shade, weather etc.) and the level of maintenance embraced by the club compared to external contractors.

To provide an indicative cost for external contractors the following should be considered.

- Sand dressed
  - Deep clean – annually $1,250
  - Light brush $1,050
- Needle Punch / Woven
  - Annual Algae/Moss spray $950

Replacement Costs

The replacement costs for two Needle Punch Carpeted greens would be approximately:

Replacement Costs (unit rates based on todays prices)		
Component	Cost per m2 / linear m	Cost of this project
Green Costs		
Site mobilisation and Documentation		16,500
Removal & disposal of existing synthetic grass surface	7.5	$ 24,000
Base rectification	4.4	$ 14,080
Needle punch carpet system installation		$ 246,400
Green Sub total		$300,980
Ancillary Costs		
Fencing (replace chainmesh)		
Lighting		
Equipment		$ 1,000
Ancillary costs Sub-Total		$1,000
TOTAL COST FOR FIELDS		$301,980

2.5. Football (Soccer)

Football has been played on synthetic grass for a number of decades with the Federation Internationale de Football Association (FIFA) embracing the benefits of synthetic turf allowing more people to play 'The World Game'. The use of synthetic grass surfaces (designated 'Football Turf' by FIFA) over the past 15 years has resulted in the development of performance standards based on quality natural turf performance standards.

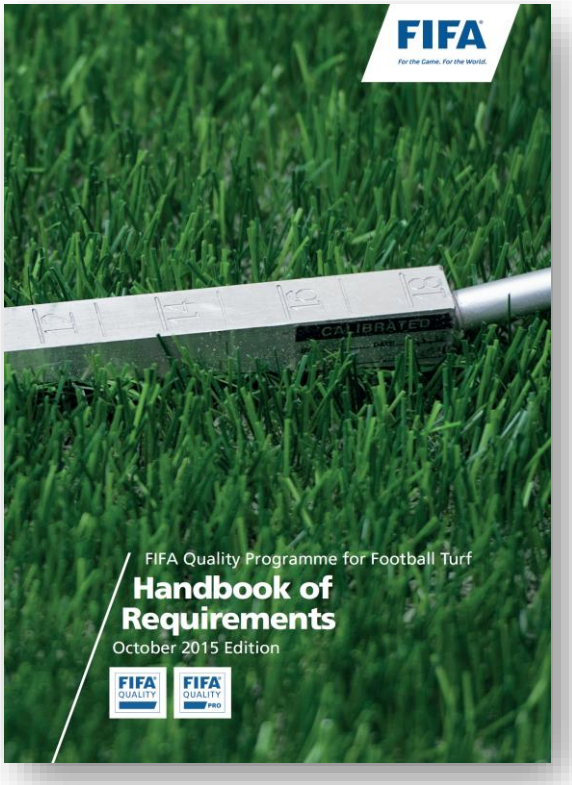
Football Standards

To ensure that the quality of football turf was consistent across the globe FIFA developed the FIFA Quality Programme in 2001 and is continually improved with the latest guidelines[13]. These guidelines were updated and re-issued in late 2015 and are constantly updated with various versions[14].

The FIFA Quality Programme for Artificial Turf is a rigorous test program for football turf that assesses the ball surface interaction, player surface interaction and durability of the product.

[13] FIFA Quality Concept for Football Turf – Handbook of Requirements (October 2015: v3.1 16.03.2020)

[14] https://football-technology.fifa.com/media/1239/fqp-handbook-of-requirements-2015-v31-w-cover.pdf



FIFA has three categories of performance standards, namely:

FIFA Quality mark field – aimed at high surface use for municipal or sports club level field (recommended for more than 20 hours use per week). This was referred to as the FIFA 1 Star previously.

FIFA Quality PRO mark field – for professional and stadium usage (recommended for less than 20 hours use per week). This was referred to as the FIFA 2 Star previously.

FUTSAL

A standard that reflects the multi-sport surfaces that are used, primarily indoors to play Futsal.

The performance standards measured are the same for both categories, although the acceptable criteria range differs slightly. This allows the FIFA Quality mark field categories have greater latitude (less than 5 percent difference in most categories) to meet the needs of the intensity that a 40 to 60-hour usage pattern would expect.

The schedule for re-testing of fields is FIFA Quality mark pitch every three years and FIFA Quality PRO recommended pitch every 12 months.

Photo 12: Kareela Oval, two Football Fields (Sutherland Shire Council, NSW)

There are a range of Facility Guides that many State Football Associations have developed to be embraced by government and sport that wish to develop such facilities. Football NSW have led the industry with their Facilities Department developing a range of Facility Guides[15], including:

- Building Development
- Drainage and Irrigation
- Field Markings and Equipment
- Grass Field Maintenance
- Football Lighting
- Project Management
- Provider Procurement and Management
- Synthetic Fields
- Football Scoreboards

2.5.1. Costs

The whole of life costs for a typical football field (8,500m^2) when considering the capital (including contingency of 12.5%), maintenance and replacement costs, would be in the region of

Whole of Life Costings	10 years	20 Years	30 years
Capital costs	$1,904,625	$1,904,625	$1,904,625
Maintenance costs	$262,000	$524,000	$786,000
Replacement costs		$466,400	$1,085,800
Totals over period	$2,166,625	$2,895,025	$3,776,425
Annual amortized rate	$216,663	$144,751	$125,881

[15] https://footballfacilities.com.au/facility-guides/

This can be broken down as follows:

Initial Capital Costs

Initial Capital Cost of Synthetic Surface Installation			
1. Type of synthetic field of play (sports name)			Football (Soccer)
2. Size of area of field			8,500
3. Field Planning and Procurement Costs	per m^2 / lin. metre		Total cost of field
Detailed site survey	$5,000.00		$5,000.00
Geotechnical investigation	$9,000.00		$9,000.00
Technical Specification and Design Package	$40,000.00		$40,000.00
Procurement	$15,000.00		$15,000.00
Project Management	$25,000.00		$25,000.00
Approvals i.e. Development Approval	$10,000.00		$10,000.00
		Field Planning and Procurement Costs Sub-total	$104,000.00
4. Synthetic Field Direct Costs			
Site establishment, documentation & project management	$100,000.00		$100,000.00
Disposal of spoil	$50.00		
Sub grade works	$40.00		$340,000.00
Drainage, gutters and concrete works	$200,000.00		$200,000.00
Base pavement (e.g. road base)	$20.00		$170,000.00
Additional costs to offset site challenges (see Part 2 Section 6)	$0.00		$0.00
Synthetic sports surface and infill	$43.00		$365,500.00
Shock pad installation	$24.00		$204,000.00
Other (if required)	$0.00		$0.00
		Pitch Sub total	$1,379,500.00
5. Synthetic Field Indirect Costs			
Field fencing / gates	$150.00		$54,000.00
Field lighting	$175,000.00		$175,000.00
Player benches / shelter	$12,000.00		$12,000.00
Equipment (i.e. shoe cleaning)	$2,000.00		$2,000.00
Retractable Netting	$50,000.00		$50,000.00
Spectator Seating	$45,000.00		$45,000.00
Pathways	$85.00		$98,328.00
Goals	$4,000.00		$8,000.00
Maintenance machinery	$18,000.00		$18,000.00
Marketing and Communications	$10,000.00		$10,000.00
Other (e.g. drinking water etc.)	$2,500.00		$2,500.00
		Ancillary costs Sub-Total	$474,828.00
Contingency Allowance	*12.0%*		$234,999.36
PM Costs	3.0%		$58,749.84
Total investment			$2,252,077.20

Figure 5: Capital Cost for a 3G Field to achieve FIFA Quality mark, with shockpad and SBR infill

Maintenance Costs

Annual Maintenance Costs			
Maintenance costs compared to usage expectations			
Component	Aus. $ cost		
Field of Play Maintenance Costs	under 40 hours	40 - 60 hours	Over 60 hours
Routine grooming	$13,000	$15,000	$17,000
Professional service grooming	$9,000	$9,000	$9,000
Algaecide / Herbicide application	$3,000	$3,000	$3,000
Visual inspection	$2,000	$2,000	$2,000
Field performance testing	$0	$0	$0
Other (please list)	$0	$0	$3,000
Pitch Sub total	$27,000	$29,000	$34,000
Ancillary Costs			
Fencing	$4,000	$4,000	$4,000
Field lighting	$3,000	$3,000	$3,000
Irrigation (if required)	$1,500	$1,500	$1,500
Goals	$0	$0	$0
Equipment (i.e. shoe cleaning)	$0	$0	$0
Retractable Netting	$0	$0	$0
Machinery maintenance	$1,500	$1,500	$1,500
Staff costs including staff training (if required)	$0	$0	$0
Other (please list)	$0	$0	$0
Ancillary costs Sub-Total	$10,000	$10,000	$10,000
Total Annual Maintenance Cost For Fiel	$37,000	$39,000	$44,000
Total cost for Field (from row 27) to match usage	$44,000		

Replacement Costs

Replacement costs for each expected replacement (10 yrs.)			
Component	Aus. $ (no CPI)		
Pitch Costs	After 10 years	After 20 years	After 30 years
Field planning and procurement	$ 55,500.00	$111,000.00	$166,500.00
Site establishment, documentation & project management	$100,000.00	$200,000.00	$300,000.00
Removal & disposal of existing synthetic turf surface	$75,000.00	$150,000.00	$225,000.00
Base rectification	$25,000.00	$50,000.00	$75,000.00
Synthetic surface installation	$365,500.00	$731,000.00	$1,096,500.00
Shock pad replacement should be every 20-25 years or allow 10% for upgrade inbetween	$20,400.00	$ 40,800.00	$204,000.00
Drainage system, pavement base and other civil works (assuming life expectancy of 30 years & 50% needs replacing)			$355,000.00
Pitch Sub total	$641,400	$1,282,800	$2,422,000
Ancillary Costs			
Fencing (replace chainmesh - allowed 33% replacement)	$17,820.00	$35,640.00	$54,000.00
Lighting (allowed 40%)	$70,000.00	$140,000.00	$210,000.00
Other (e.g. drinking water etc.)	$500.00	$1,000.00	$1,500.00
Mobile Equipment (allowed 100%)	$18,000.00	$36,000.00	$54,000.00
Fixed Equipment (allowed 20%)			
Ancillary costs Sub-Total	$106,320.00	$212,640.00	$319,500.00
Contingency costs (15%)	$112,158.00	$224,316.00	$411,225.00
Total Replacement Costs for Field of Play	$859,878.00	$1,495,440.00	$2,741,500.00

2.6. Gridiron / American Football

In 1969, Franklin Field, University of Pennsylvania switched from grass to artificial turf. Over the past 40 years some of the National Football League (NFL) teams have changed back to natural grass, with some also deciding to reinvest in the latest generation synthetic technology. The University of Pennsylvania is one example that switched from synthetic (2nd generation) to natural grass before reverting to a 3rd generation pitch.

In Canada all eight stadiums in the Canadian Football League (CFL) use synthetic sports turf.

There are no standards for gridiron / American football except the Clegg Hammer Test which measures hardness. If an organisation was to consider this in Australia / New Zealand, it is recommended they should consider the World Rugby or AFL/Cricket Australia standards, especially due to the critical head fall criteria.

2.7. Hockey

Hockey, under the guidance of the International Hockey Federation (FIH), has been promoting the use of synthetic surfaces since the first surface was used in Canada in 1976 for an international game.

Photo 13: London Blue Hockey Field, as it is now known (source: Polytan)

In their latest handbook for synthetic surfaces[16] FIH state that their objectives to code the relevant performance requirements is to ensure that hockey pitches and matches are conducted for:

- Consistency – to reflect relative team merit,
- Quality – to provide an opportunity for players to display and develop their skills,
- Safety – to ensure playing conditions offer comfortable playing considerations and reduce risk to players/officials, and
- Playability – to extend playability, especially in adverse weather conditions.

FIH are keen to promote the game across the world and believe that the use of synthetic sports and synthetic hockey surfaces will provide greater access to facilities to participate in various forms of hockey. By providing quality, safety and consistency of play, participants will feel more confident in developing their skills, enjoying the game more and FIH hope, continue playing the game throughout their life.

2.7.1. Standards for the Sport

Hockey, under the guidance of the International Hockey Federation (FIH), has been promoting the use of synthetic surfaces since the first surface was used in Canada in 1976 for an international game.

In 2017 they updated their global standards to include the following categories:

- **Global Elite** – fields designed to satisfy the competition requirements of FIH Tier One hockey events. These fields are surfaced with Global Approved Products and require watering prior to play.
- Global – fields designed for international and top-level national competitions, they also are surfaces with Global Approved products and require watering prior to play.
- National – this category of field may be used for competitive play when dry or wet. Normally surfaced with a National Approved Product (Class 1 or 2) the fields are used for lower level national, regional and club play.
- Multi-Sport Surface – recognising that facilities on which hocky is played also often have to be used by other sports, the FIH Quality Programme for Hockey Turf includes three categories of Multi-Sport Surface. Multi-Sport 1 and Multi-Sport 2 Approved Products are based on sand dressed or sand filled synthetic turf surfaces or textile surfaces, that are laid on shockpads that provide slightly wider ranges of performance than those used specifically for hockey.
- Hockey **5's Courts** – there are four standards for Hockey 5's courts, including Global elite, Global, National and Multi-Sport.

[16] Handbook of Performance, Durability and Construction Requirements for Synthetic Turf Hockey Pitches (FIH – May 2013)

It is also expected that in July 2020 there will be a new standard that offers certification for Football (Futsal), Hockey 5's, Netball and Tennis.

These are the key aspects that FIH have identified to underpin their performance requirements[17].

i.) The performance standards aim at allowing players to use the fields in a safe and comfortable manner,

ii.) Approved products from licensed manufacturers are published on the FIH website (www.fih.ch) which has been tested by an FIH accredited laboratory, demonstrating compliance to the appropriate FIH standards. These products are only valid for the specified duration, and

iii.) Pitches are granted a certificate of compliance after field testing by an accredited laboratory, only when they meet the specified performance standards. A current list of certified pitches is published on the FIH website (www.fih.ch) which are valid for two (2) years from the date of testing.

Product Licensing

Manufacturers of synthetic turf for hockey pitches or multi-sport used for hockey may apply to the FIH to have their products registered as FIH approved products. Once tested by an independent and accredited laboratory they are listed on the FIH website. Only licensed manufacturers, their subsidiaries and licensees may seek FIH approval for their products.

2.7.2. Costs

The whole of life costs for a typical hockey national standard field (6,500m^2) when considering the capital including contingency of 12.5%) $1.2m, maintenance $12,000 and replacement costs allow $40,000 annually.

2.8. Rugby League

Rugby League in Australia and New Zealand is controlled under their national governing body, namely the National Rugby League (NRL) in Australia and the NZRL in New Zealand.

The International Federation for the sport, the Rugby League International Federation (RLIF) currently seems to have limited scope in relation to synthetic surface governance.

Photo 14: Australia's first Rugby League only field in Blacktown (NSW)

The UK's governing body for Rugby League, the Rugby Football League (RFL) have embraced the technology and set standards which have been used at both community and stadium/professional level. In Australia, the National Rugby league (NRL) has worked with the English RFL and has adopted their standards and enhanced them for Australia.

2.8.1. Standards for the Sport

The original Rugby Football League (RFL) standard based on the European Standard EN 15330-1: Surfaces for Sport Areas has been modified for the specific requirements of Rugby League in 2020. The standard takes into account the results of a comprehensive study into the performance of natural grass pitches.

Recognising that many artificial turf Rugby League pitches will also be used for Football or Rugby Union the NRL are updating their current standard and should be issued in the middle of 2020, aligning it with the requirements for FIFA and World Rugby Regulation 22 wherever possible.

Similar to the FIFA Quality Concept, the NRL performance standard recognises requirements for community and stadium use. Products suitable for Rugby League play must pass initial laboratory approval before being allowed to be installed and tested in the actual field application.

The NRL standard specifies two categories of performance: The category called 'stadium' is intended to replicate the characteristics of high-level natural grass as found in well maintained stadium settings. Surfaces meeting the 'stadium' category are intended for use in

[17] Handbook of Performance, Durability and Construction Requirements for Synthetic Turf Hockey Pitches (FIH – May 2013)

professional matches and training. The second category called 'community' which has a wider acceptance range than the stadium category is supposed to replicate the characteristics of good quality community natural grass fields.

Whilst community pitches shall be retested every two years, stadium pitches require a field retest on an annual basis.

In general, community grounds have to sustain a much higher level of use compared to stadium pitches that are predominantly used for competition matches and professional training. In this respect, the NRL categories 'stadium' and 'community' are comparable to the FIFA Quality PRO and Quality marks.

Product Licensing

There is no product licensing presently in Australia, or by the world governing body.

2.8.2. Costs

The costs of a Rugby League standard field are similar to that of Football and Rugby Union and for a typical 9,120m^2 field of play. The capital costs would be approximately:

Initial Capital Cost of Synthetic Surface Installation		
1. Type of synthetic field of play (sports name)		**Rugby League**
2. Size of area of field		**9,120m^2**
3. Field Planning and Procurement Costs	**per m^2 / lin. metre**	**Total cost of field**
Detailed site survey	**$5,000.00**	$5,000.00
Geotechnical investigation	**$9,000.00**	$9,000.00
Technical Specification and Design Package	**$40,000.00**	$40,000.00
Procurement	**$15,000.00**	$15,000.00
Project Management	**$25,000.00**	$25,000.00
Approvals i.e. Development Approval	**$10,000.00**	**$10,000.00**
Field Planning and Procurement Costs Sub-total		**$104,000.00**
4. Synthetic Field Direct Costs		
Site establishment, documentation and project management	**$100,000.00**	$100,000.00
Disposal of spoil	**$50.00**	
Sub grade works	**$40.00**	$364,800.00
Drainage, gutters and concrete works	**$200,000.00**	$200,000.00
Base pavement (e.g. road base)	**$20.00**	$182,400.00
Additional costs to offset site challenges (see Part 2 Section 6)	**$0.00**	$0.00
Synthetic sports surface and infill	**$43.00**	$392,160.00
Shockpad installation	**$24.00**	$218,880.00
Other (if required)	**$0.00**	$0.00
Pitch Sub- total		**$1,458,240.00**
5. Synthetic Field Indirect Costs		
Field fencing / gates	**$150.00**	**$54,000.00**
Field lighting	**$175,000.00**	**$175,000.00**
Player benches / shelter	**$12,000.00**	**$12,000.00**
Equipment (i.e. shoe cleaning)	**$2,000.00**	**$2,000.00**
Retractable Netting	**$50,000.00**	**$50,000.00**
Spectator Seating	**$45,000.00**	**$45,000.00**
Pathways	**$85.00**	**$98,328.00**
Goals	**$4,000.00**	**$8,000.00**
Maintenance machinery	**$18,000.00**	**$18,000.00**
Marketing and Communications	**$10,000.00**	**$10,000.00**
Other (e.g. drinking water etc.)	**$2,500.00**	**$2,500.00**
Ancillary costs Sub-total		**$474,828.00**
Contingency Allowance	***12.0%***	**$244,448.16**
PM Costs	**3.0%**	**$61,112.04**
Total investment		**$2,342,628.20**

The expected Whole of Life costs of the fields would be:

Whole of Life Costing Amortisation			
Whole of Life Costings	**1-10 years**	**11-20 years**	**21-30 years**
Capital Costs	**$2,342,628**		
Maintenance Costs	**$440,000**	**$880,000**	**$1,320,000**
Replacement costs (at yrs. 10,20 & 30)		**$892,248**	**$1,551,736**
Total WOL (over 10, 20 & 30 years)	**$2,782,628**	**$4,114,876**	**$5,214,364**
Total M&R (over 10, 20 & 30 years)	**$440,000**	**$1,772,248**	**$2,871,736**
Annual Whole of Life Cost Average	**$278,263**	**$205,744**	**$173,812**
Annual Maintenance and Replacement Average	**$44,000.00**	**$88,612.41**	**$95,724.53**

2.9. Rugby Union

Rugby Union has historically been played on grass, despite several proposals over the years for alternative solutions, including clay, shale, sand and the Second-Generation artificial grass. All presented a similar problem of critical head fall and skin abrasion.

Photo 15: Rugby Union playing on Blackman Park, Lane Cove, NSW (installed by Team Sports, 2013)

In the past half-decade, the technology around synthetic turf has provided proven solutions for the game of rugby and the rugby world has embraced this because of the benefits for increasing participation, quality of play and consistency for the game.

2.9.1. Rugby Union Standards

To ensure the quality and consistency of the surface, World Rugby developed the Artificial Rugby Turf Performance Specification[18], in consultation with FIFA. This standard was integrated into the Game Regulation 22[19] and provides guidance on how it can be used for the game.

World Rugby has only one standard for synthetic turf, that applies to both community and stadium use. Similar to the FIFA performance standards, World Rugby has identified three basic categories that are broadly defined as:

- Ball/surface Interaction: The reaction of a ball to the surface
- Player/surface Interaction: The reaction of a player to the surface
- Durability: The resistance of the surface to wear and tear and the environment
- The performance criteria can be sourced at www. http://playerwelfare.worldrugby.org/

World Rugby Preferred Turf Producer

The following companies are Preferred Turf Producers (PTP's) and a full updated list can be found on the World Rugby website (www.irbplayerwelfare.com):

- Edel Grass B.V. (N/A),
- FieldTurf Tarkett SAS (Turf One),
- Greenfields B.V. (HG Sports Turf),
- Limonta Sports C.P.A. (Greenplay Australia), and
- Polytan.

Field Installations

Over the past few years global embracing of synthetic turf for Rugby Union has progressed significantly with countries such as Canada (3 fields); China (1); Hong Kong (3); France (23); United Kingdom (15); and New Zealand (8) installing the surface. Within Australia there are a number of competition fields including Blackman Park, Lane Cove, Randwick (x 2), Moore Park and Woollahra.

2.9.2. Cost

The costs of a Rugby Union field are very similar to that of a Rugby League field (see previous costs, Section 2.8).

[18] IRB Artificial Rugby Turf Performance Specification One Turf Technical Manual

[19] Regulation 22: Standard relating to the use of artificial rugby turf

2.10. Tennis

The International Tennis Federation (ITF) has developed a series of 'Court Surface Association Programs' that categorise the speed of the courts and quantify the quality of installation. Irrespective of the surface type, the two programs explore the pace of the surface through the ITF Court Pace Classification Program. The ITF Recognition Program allows for both products to be tested against the Court Pace Classification Program and individual courts can be rated.

2.10.1. Types of Surface

The types of surfaces that are recognised by the ITF have been classified in their publication ITF Approved Tennis Balls, Classified Surfaces and Recognised Courts. A Guide to Products and Test Methods[20] and are summarised in Table 3 below.

Table 3: ITF Approved Tennis Balls, Classified Surfaces and Recognised Courts

Surface code	Type	Description
A	Acrylic[1]	Textured pigmented, resin-bound coating
B	Artificial Clay[2]	Synthetic surface with the appearance of clay
C	Artificial grass[2]	Synthetic surface with the appearance of natural grass
D	Asphalt[3]	Bitumen-bound aggregate
E	Carpet	Textile or polymeric material supplied in rolls or sheets of finished product
F	Clay[4]	Unbound mineral aggregate
G	Concrete[3]	Cement-bound aggregate
H	Grass	Natural grass grown from seed
J	Other	e.g. Modular systems (tiles), wood, canvas

Notes: All surfaces may be porous or non-porous, with the exception of 'clay' and 'grass', which are always porous.

[1] Normally forms only the uppermost few millimetres of a court.

[2] "Appearance" relates only to the form of the uppermost surface material and no other characteristics (e.g. colour). These surfaces are typically composed of a carpet matrix dressed with clay, sand and/or rubber aggregate.

[3] Used only when the material itself forms the playing surface. When used as a base for other surfaces (e.g. acrylic), reference will be made only to the playing surface.

[4] This term denotes a type of surface that is constructed from naturally-derived materials, and includes unbound sand or clay.

ITF Court Pace Classification Program[21]

To assist clubs and tennis organisations to select the surface most suited to their requirements the ITF Court Pace Classification Program identifies the surface into one of five (5) categories:

Slow	≤ 29,
Medium-slow	30 – 34,
Medium	35 – 39,
Medium-fast	40 – 44, and
Fast	≥ 45.

Photo 16: Andy Murray returns a shot at the Australian Open on the cushioned floor (source: Martin Sheppard)

The court pace is established by using a simple test[22] which records the velocity before and after the bounce. The increased smoothness of the court surface increases the speed of the ball and similarly the rougher the surface the more it slows the ball down. Additionally, the higher a bounce a surface produces the slower the court will be because players have more time to reach the ball. Both of these factors are reviewed.

A product that has been tested in an ITF Accredited Laboratory (on site or in a laboratory) is included purely on the Court Park Rating and is classified for three (3) years. This list can be seen as part of ITF's website (www.itftennis.com).

[20] www.itftennis.com/technical
[21] https://www.itftennis.com/en/about-us/tennis-tech/recognised-courts/

[22] ITF Approved Tennis Balls, Classified Surfaces and Recognised Courts – A Guide to Products and Test Methods

ITF Recognition Program

The ITF Recognition Program is targeted at those venues where the standard of play demands the specification of precise playing characteristics. Although the ITF states that this may include regional tennis centres or where national/international tournaments may be held, it is just as relevant as a quality control progress to ensure that the court standards and pace required have been delivered.

There are two levels of recognition, which according to the ITF[23] guidelines state:

i.) One-Star ITF Recognition, and
ii.) Two-Star ITF Recognition.

The ITF Recognition Programme is targeted at those venues where the standard of play demands the specification of precise playing characteristics, e.g. at international tournaments and national or regional tennis centres.

- One-Star ITF Recognition

Key installation properties of a court must meet ITF recommendations, which include a visual inspection to identify any cracks or gaps in the surface and to confirm that the appearance is uniform. Any bumps or dips in the surface are measured and the slope and planarity of the court are established. Finally, the positions of the court markings and net are checked to ensure they are within acceptable limits.

- Two-Star ITF Recognition

In addition to the One-Star ITF Recognition process, the Court Pace Rating is compared with the ITF Classified value for the surface product. Therefore, only surfaces which have obtained ITF classification can be tested for Two-Star ITF Recognition. If the surface product is not classified, the supplier can apply for ITF classification using the results of the on-site Two-Star Pace Rating test.

- Applications and Validity

An application for ITF Recognition can be submitted by any party with interest in the tennis facility, such as the owner, the organiser of a tournament held at that facility, or the supplier or installer of the court.

ITF Recognition expires when the court is resurfaced, or after 10 years, depending on which is sooner. However, the results are only valid on the day of testing, as properties of the court may change, due to factors such as ambient conditions, use and maintenance[24].

If the venue is therefore used for competitions annually at a high level it should be re-tested accordingly.

The application for ITF Recognition can be submitted by the installer, court owner (e.g. Local Government), the tennis club or peak body (e.g. Tennis NSW etc.) or a tournament organiser.

If successful, the results for the venue and courts will be published on the ITF technical website for a One-Star Recognition. If a Two-Star is established the product brand name will also be displayed.

ITF Recognised Supplier or Installer

Suppliers who have obtained a certain number of ITF Recognition awards for their courts will be awarded Elite ITF Recognition Supplier/Installer status, in recognition for their continued quality of their products and workmanship.

The two levels are:

- Elite Silver Level – for 10 or more installations as either an installer or supplier, and
- Elite Gold Level – for 50 or more installations as either an installer or supplier.

Within Australia the governing body of tennis is Tennis Australia (www.tennis.com.au).

2.10.2. Costs

The following table provides an estimate for the typical costs for the above systems.

Acrylic System	Rate (/m²)
Multi-layered acrylic system	$12.50 – $14
Liquid applied cushioned acrylic system	$50
Prefabricated acrylic system	$50 – 70
Gel system	$55

2.11. Multi-Sport and Multi-Games Areas

With the changing trends from traditional community sport participation to active recreation coupled with the growing sedentary lifestyles of adults and especially children new facilities can and should be developed in a manner that encourages increased play for children and young people.

[23] ITF Court Surface Assessment Program

[24] ITF Court Surface Assessment Program (pg. 6)

Photo 17: Multi-games area, used for schools and local parklands

The development of Multi-use Activity Zones has taken traction in Europe and is now starting to gain interests in Australia. Many local governments have embraced the multi-games areas where the designs have evolved around youth play areas and multi-sport play areas.

These Multi-Use Activity Zones are colourful and encourage greater usage but are not designed to meet any performance standards, just safety standards.

2.11.1. Multi-Sport Standards

There are a number of multi-sports and multi-games area guides or standards including:

1) One-Turf Standard

Aimed at the long turf (3G) sports of Football (Soccer), Rugby Union and Hockey (Multi-sports standard).

In Australia, the common approach is to utilise the individual 3G Football codes of Soccer, Aussie Riles, Rugby League and Rugby Union. By identifying specific additional requirements around durability, porosity, environmental mitigation strategies and design parameters.

The One-Turf standard can be sourced from Word Rugby Player Welfare site[25]

2) Gen 2: Multi-sports Areas – Sports Pitch Design Guideline

Focussed on combining the sports of Hockey 5's, Netball, Tennis with others such as Futsal, mini-soccer, Lacrosse, Softball, Korfball and fitness/athletics training. This new standard (2020) allows for the integration of these key short pile surfaces to meet the needs of the sports.

This can be sourced from: http://www.fih.ch/inside-fih/fih-quality-programme-for-hockey-turf/facility-guidance-resources/

3) Multi-use Games Areas

Many of these developments do not use any design, guidelines or surface standards, and aim at meeting the recreational needs of many 'sporting activities' which may include 3 on 3 basketball, netball, 5-a-side football, hockey 5's, fitness training. It is important that if there is a chance that these multi-use areas will be used by older children or adults, then the safety of the surface should be considered by exploring embracing the Gen 2 – Sports Pitch Design Guidelines approach.

Photo 18: Football and Hockey field (source: Team Sports)

In Australia there is only one published standard to date that formally combines two sports and that is the AFL/Cricket Australian community surface standard. The reality of this standard is that it is predominantly for Aussie Rules, as the cricket wicket has no standard, just the outfield.

Photo 19: Multi-sports field Moore Park, NSW (source: Centennial Parklands Trust)

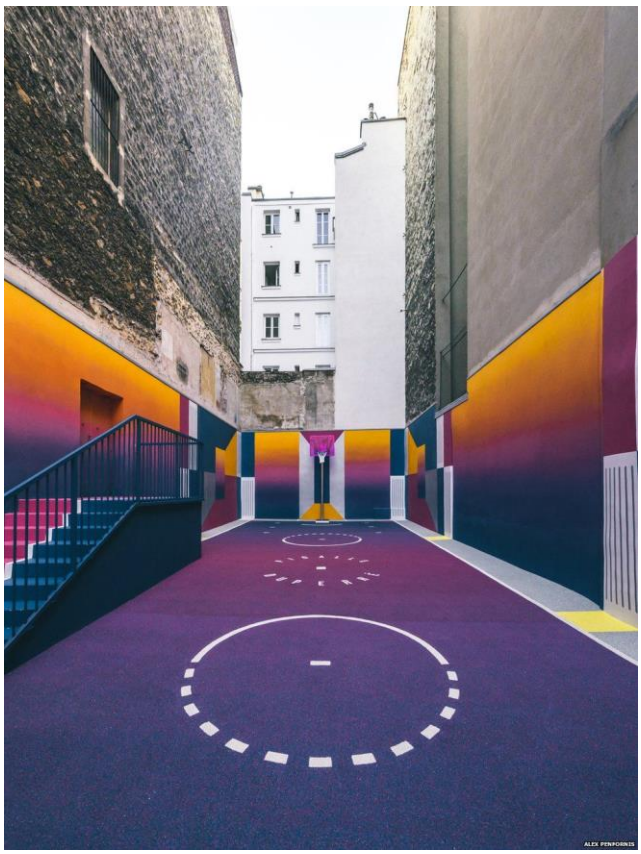
[25] https://playerwelfare.worldrugby.org/?subsection=78

The benefits for the client or purchaser will be that they can program many sports at different times of the year, which could be very beneficial. Although there is a common standard, known as the 'One Turf' standard, it has not been embraced in Australia and the specific sports are specified.

2.12. Conclusion

The challenges facing both sport and government relate to satisfying the growing demand, as the population continues to grow. Embracing the synthetic sports surface technology around single sport, multi-sport, recreational and elite surfaces allows for increased usage.

There are a range of technological solutions that meet the majority of play, recreational and sporting needs. This is reflected in the number of schools who are embracing the technology to replace asphalt and seeing the results of a growing number of children enjoying playing on the new surface.



Multi-use sports or Active Sports Zones are now becoming more and more popular for encouraging casual sports recreation by combining facilities where many sports can be played locally such as 5-a-side, basketball, netball, cricket etc.

The International Federations have all embraced the technology and established the base standards that need to be achieved for community fields. Smart Connection Consultancy believe that for Australia, their base standards need to be enhanced in some areas to meet the Australian conditions, especially around durability, UV radiation and porosity.

3. Synthetic Sports Turf Surfaces

3.1. System Components

The quality of performance of the playing surface is influenced by the components that make up the overall synthetic sports turf system. All of these components are as important as each other, with the civil engineered solution for the pavement and drainage probably more important than any other aspect longer term.

The 'system', as it is commonly referred to, consists of the pavement, base and drainage solution which the performance surface sits upon. The performance grass system which has the synthetic carpet (yarn, backing and infill) as well as the shockpad.

3.2. Synthetic Turf Yarn

3.2.1. Yarn Manufacturing

The synthetic turf aspect of the system has yarn that is developed through an extrusion process from a combination of polymers to provide either a softer polyethylene based fibre or a slightly harder polypropylene fibre. The first generation was made from nylon (polyamide) yarn, which was prone to friction burns due to its coarse nature.

Photo 20: Extrusion Process producing mono-filament yarn

The current manufacturing process produces one of two forms of yarn, a monofilament single thread of yarn or a slit-film tape, commonly known as fibrillated yarn. The process for both types of yarn includes taking the raw materials, namely the polyethylene polymer (which is almost exclusively used for long grass fields) with the colour and melting them in an extruder.

The melted and coloured material is then either pushed through a spinneret (similar to a thick spaghetti maker) to the shape of the monofilament and then cooled, or formed into a film, cooled and then perforated in a fibrillated tape.

The mix of polymers follows the above process. The formulas of the polymers are a proprietary intellectual property of the yarn manufactures as they strive for the right balance between fibre rigidity (to keep the fibre upright) and softness, for feel and skin/player interaction.

3.2.2. Yarn Manufacturing Parameters

The key variables that need to be considered with the yarn include:

- **UV Resistance**

As Australia has one of the most aggressive climates with one of the highest UV levels in the world, it has a direct impact on the longevity of the synthetic turf system. The yarn should be provided with a warrantee against UV. Some cheaper yarns that are being imported into Australia may not have been tested to the appropriate levels needed, and this should be considered. The UV stabilisation is a big part of the yarn cost and is tested using a QUV machine that exposes the yarn to high levels of artificial UV light and combined with artificial weathering (heat, light, rain etc.) simulates eight years of exposure. This now involves 5,000 hours of testing.

The Australian standard that the surface needs to adhere to is AS2001-4: B02-2001, for minimal UV degradation.

- **Colour Fastness**

Extensive weathering such as heat, rain and wind can impact on the colour fastness of the pigments in the yarn. When combined with intensive play, the pigments, if not stabilised with the yarns' polymers, can cause accelerated breakdown. In some earlier yarns (pre-2002) the use of heavy lead pigments (e.g. lead chromate) were used. The key manufacturers in the late 1990's embraced the EU Packaging Directive removing heavy metals from recycled plastic packaging products (1994). Some cheaper imported products may not have embraced these standards. It is important that any purchaser of synthetic surfaces ensures that this is adhered to by the supplier.

The Australian standard for colour fastness in artificial light, which can be used to test the colour fastness, is AS2001-4 BO2-2001 which also addresses the minimum UV degradation.

The safety of the colour pigment is not addressed by any Australian standard and the European DIN standard 18035 states that the levels should be:

Table 4: Acceptable heavy metal levels (source: DIN 18035)

Heavy Metal	Acceptable Level	Units
Lead	<0.04	mg/L
Cadmium	<0.0005	mg/L
Chrome Total	<0.05	mg/L
Mercury	<0.001	mg/L
Zinc	<3.0	mg/L

- **Length of Yarn**

The length of the yarn is determined by the purpose of use, whether that is 11mm for Hockey, 60mm for Rugby Union or 220mm for synthetic horse racing tracks. Some sports determine the length of the yarn (e.g. Rugby Union at 60mm minimum) while others focus on the performance outcomes only.

Table 5: Example of yarn height ranges for each sport

Sport	Normal Range
Bowls	10mm - 15mm
Football (11-a-side)	50mm - 60mm
Football (5-a-side)	20mm - 60mm
Rugby League	60mm minimum
Rugby Union	60mm minimum
Tennis	10mm - 25mm
Australian Rules	50mm - 65mm
Hockey	10mm - 45mm
Cricket Wicket	9mm - 12mm

From experience we have found that with a football field with a 40mm-50mm yarn, the disbursement of the infill being 'kicked out', has meant that the infill 'disappears' down to the sand quickly. So, we would suggest a minimum of 50mm length for large ball sports.

There is balance between the thickness of the yarn, which may assist with its ability to remain standing and the softeners of a slightly thinner yarn. Over the years, manufacturers have tried many sorts of yarn types to optimise the balance of thickness and softness to polymers.

- **Yarn Extrusion Options**

When the yarn is extruded, there are normally five (5) broad options:

- ***Monofilament fibre*** – a single length or blade which tries to replicate that of a single blade of natural grass. A grass with this yarn would normally have a greater amount per square metre. It is also renowned for staying upright longer and being more durable.
- ***Fibrillated yarn*** – the yarn is produced in a sheet (slit-film sheet) then cut to the width desired, so the texture has more uniformity than the single blade of the mono-filament yarn with the superior turf bind and economies of a fibrillated yarn.
- ***Hybrid system*** – some manufacturers are offering a combined yarn system that offers the aesthetics and durability of a monofilament yarn with the superior tuft bind and economies of a fibrillated yarn.
- Knit-de-knit – straight yarn that is given the tight curly appearance for hockey pitches, producing a non-directional surface.
- ***Texturised*** – straight yarn that is heat-set to produce a tight curly appearance which is non-directional to meet the needs of hockey. This approach is also used for the "thatch" part of the 'grass-system' mainly for landscape grass, reducing the need for infill.

- **Cooler Grass Technology**

Most of the manufacturers have a proprietary approach to the reduction the heat retention in the yarn, some claim by 20-30%. This is worth considering when purchasing. It is always worth considering the question 20-30 percent of what? This reduction normally occurs because the polymers in the yarn are able to reflect infrared and dissipate heat into the atmosphere, as opposed to absorbing them into the yarn.

- **Pile Weight/Density**

Identifying the quality of yarn within a square meter, using the number of stitches and the gauge manufacture. As a rule, the tighter the pile, the higher the price. The linear density is a measure of the weight of the yarn, and is referred to as the 'Denier'.

3.2.3. The Carpet Backing

The backing material is critical as it holds the tufted or woven yarn in place but also needs to be durable enough to hold the field in place, so there is no shrinkage or expansion. It is also critical for connecting each roll of grass on the field, allowing water to pass through the surface.

The tufted yarn option is predominantly tufted through the backing and the yarn needs to have a coating or glue type bonding agent so that the tufts cannot be easily moved or pulled out.

The most commonly used coating is a polyurethane (PU) bonding agent, due to its superior water resistance. Latex, thermo-plastic coatings, natural rubber and other bonding agents can also be used. The porosity of the backing is normally achieved in one of two ways; either using a heat soldering hole and puncturing across the roll of grass, or having the polyurethane backing only attributed to the yarn tufted areas and the space in between the tufts is therefore more porous.

The majority of carpet backing is double backed with the 'second backing' sprayed on to seal the carpet tufts. Some manufacturers only 'seal' the turf and gauge, leaving the space between not double sealed, allowing for greater water porosity. These pictures below provide an understanding of the two key options.

The water porosity through the carpet backing must be achieved for the key sports. For instance, in Football (Soccer) the FIFA guidelines are 180ml per hour. In Rugby Union, the World Rugby guideline is 500ml per hour, whilst Australian Rules (AFL) is 200ml. Smart Connection Consultancy recommends all pitches should have a porosity rate of 500ml per hour. It is important to design drainage rates to cope with this. The important aspect is that the drainage system needs to be able to cope with the level of rain that the porosity requires.

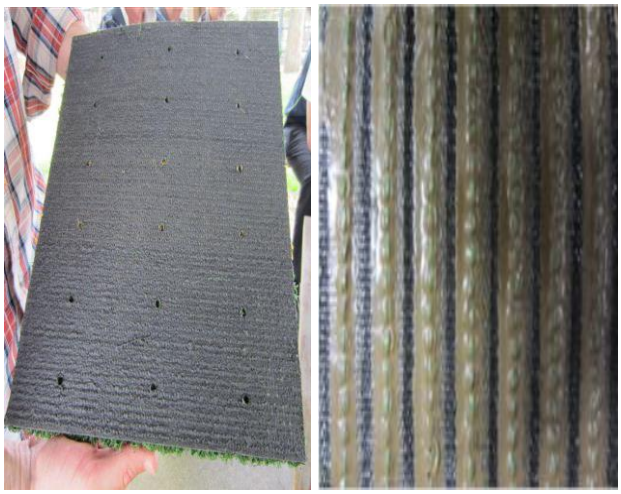


Photo 21: Examples of Backing Surfaces

3.2.4. Carpet Seams and Joining

The carpet is normally created on rolls of 3.2m-4.5m in width and these are laid width wise across the field. The 'straight lines' are normally integrated when woven and the circular lines laid at installation.

Any other straight seams are usually secured by sewing or using an adhesive, depending upon the manufacturer's system. The important point is that the carpet should be seamless and have a maximum possible joint strength.

The adhesives used should be proven in Australia and are not considered volatile in adverse weather conditions (e.g. heat, rain, wind, humidity etc.). The FIFA assessment standards (Quality Manual – 2015) state that as part of the certification process that a visual inspection will be conducted to ensure that there are no significant defects, these include:

- Failed or excessively open joints (greater than 3mm)
- No looped pile

Photo 22: Example of seam failure

3.3. Infill

The infill within the 3G long grass synthetic turf aims to provide a consistency between the ball, player and surface interaction that allows the synthetic system to perform to the required standards set by each sport (e.g. FIFA, World Rugby etc.).

There are a number of aspects that need to be considered when choosing the most appropriate infill for a sports field including:

- The type of infill for the surface;
- The depth and height of the infill compared to the yarn, and
- The amount of infill per metre^2.

3.3.1. Purpose of Infill

The infill, or lack of it, is needed to assist the performance of the whole synthetic grass system, which ensures that the infill plays a similar role as the soil in natural grass fields. The different types of grass surfaces that are commonly categorised are as follows:

1) Unfilled

Although the first nylon pitches in the 1960's were unfilled, the pitch systems are far more sophisticated now-a-days. Water is used; predominantly for hockey's premium standard – global. Water is applied through an irrigation system immediately prior to play, increasing the speed of the ball interaction with the surface. Technology is now looking for infilled fields that have similar playing conditions as traditional water-based pitches. Many are sand dressed instead.

The next generation of surfaces in Europe are being tested for football codes using no infill. This has not been proven over time yet, so the jury is still out. Some fields seem to be more slippery and the head impact consequences a concern.

2) Sand-Dressed

Dressed synthetic surfaces aim to add weight to the carpet to keep the denier pile upright while also maintaining the playing standards for hockey. Some football (soccer) 5-a-side/futsal courts use this type of system as it seems to provide a more durable solution to people using flat training shoes.

Photo 23: Example of a mixed profile of sand and rubber infill

3) Filled Fields

The aim of the filling is to replicate the sand or soil profile in a natural pitch where the grass/synthetic yarn is held upright. The filling can be compiled from rubber, sand or organic infill's. The amount of fill is normally determined by the manufacturer, when they consider the length of grass yarn, the performance outcomes, the shockpad and purpose of the field. For instance, rugby union has to be at least 60mm, whilst hockey can be around 11mm.

3.3.2. Type of Infill

Depending on the manufacturer's systems, there will always be a choice for the purchaser depending upon the affordability and philosophical standing. Some Local Governments do not like the idea of using recycled types (SBR) due to community perceptions, although these perceptions have been proved unfounded. In terms of sustainability approximately 20,000 recycled tyres are used per 9,000m^2 typical football turf field. In essence there are five types of infill, all offering slightly different options, but with the same outcome, namely the performance standards stipulated by the sport(s). The key options are:

1) Crumbed Rubber (SBR)

This is the most popular infill in the Asia Pacific region, probably due to the cost-effective price point. It is derived from recycled truck tyres that are ground up and recycled. Two types of crumbled rubber are used – ambient and organic. They are both predominantly metal free, and according to the United States, Synthetic Turf Council's (STC) Guidelines for crumb rubber infill should not contain liberated fibre in the amount that exceeds 0.01 percent of total weight of crumbed rubber.

Recycled and shredded rubber is normally 0.5-2mm in size, is the least expensive and still provides the necessary sliding and shock absorbing qualities. The shredding of the rubber is normally completed mechanically. Sifting technology is used to ensure that the dimensions are correct. The benefits are that it is recycled, economical, UV stable and has a long-life span.

The black rubber has, according to the UK's Sport and Play Construction Association's (SAPCA) independent Consultant polymer chemist, Dr Bryon Willoughby, been "selected to offer optimum performance in a demanding application which requires strength, fatigue and abrasion resistance". SBR is a general-purpose rubber.

Both the ambient and cryogenically shredded rubber can be coated with obscurants, sealers or anti-microbial substance if required. This approach provides a great aesthetic appeal, but the additional cost may not justify it for may LGA's. From examples in Australia, these coated infills have not been successful.

2) Sands

Silica sand is the preference for sports fields due to the rounding of each particle, as opposed to the sharpness of natural sand, as you would find on the beach. This sand is chemically stable, fracture resistant, non-toxic and is rounded.

Photo 24: Silica Sand (source: www.flexsand.com)

It can be used by itself, as seen in some sites in Victoria and ACT or in combination with rubber or organic infills. It is important that the Silica sand has a high purity of grains of more than 90 percent as recommended by the STC. This sand can also be coated with either a firm or flexible coating which is normally elastomeric or acrylic, forming a coating that allows for different sizes depending on the system's needs.

3) TPE (Thermo Plastic Elastomer) or TPV

This is a new material, which is heated and compressed into grains or various shapes for performance. Once cooled, it retains its new shape, is elastic in nature and can also be recycled. It has a long life and shows durability according to various manufacturers. There does seem to be some question about its suitability in hot climates over 40 degrees and its ability to retain its structural integrity.

This 'virgin plastic' infill is non-toxic, chemically stable, resits fading and is long lasting. It can also provide the benefit of being recycled at the end of the "grass life". Providing a wide range of colours, TPE is often used in playgrounds, athletic tracks as well as for field infills. It has elastic properties; uniform shape and its virgin rubber and filling provide a high-performance infill option.

4) EPDM Infill (Ethylene-Propylene-Diene-Rubber)

This type of infill is produced from a polymer recovered from three monomers: ethylene, propylene and diene. It is manufactured new with options for various colours made to order.

Photo 25: EPDM infill (source: Smart Connection Consultancy)

It is odourless and offers consistent quality. It is often used beside playgrounds and on tracks as well as for performance infill. It is commonly coloured in light colours and provides a significant contrast from the traditional black SBR.

5) Organic Infill

There seems to be some experimentation using organic or natural infills by a small number of companies. The mix of the organic infill may have a bearing on other considerations. The basic approaches seem to be:

i.) **Cork infill** – allowing cork to be stripped from trees (every nine years) then used as a top-up type infill with similar rebound qualities as the larger rubber patches. As it takes on a small amount of water it will not break down as quickly as other organic infills. It is cooler when wet than rubber, stable and retains its shape. The marketing rationale from a key supplier states that it has 12 million air cells per cubic cm. It is the costliest, but an excellent solution.

ii.) **Cork/organic infill** – allowing less cork with other plant/organic compounds such as coconut husk etc. There seems to be more concerns about this combination due to:

- The plant/organic compound breaking down quickly with the typical level of use that Australian LGA's programme their pitches (e.g. 40-60 hours).
- Additional cost of maintenance due to compaction and possible organic growth with plant substance.
- Additional cost of continual replacement and top-up.

- This option, in Australia's climate also needs to be watered regularly as it will turn to dust with the breakdown of the natural fibres.

Some would say this negates the benefits of synthetic turf and a hybrid stabilised turf/grass solution should be considered. We would not agree, as a hybrid surface only has 9% synthetic fibres so would only be able to cope with 30 hours of use.

Photo 26: Organic infill (source: Limonta)

This could be a significant operational cost by having the organic infill which could be an additional $10,000 p.a. Many people see the benefit of this.

3.3.3. Future Considerations for Infill

European suppliers are promoting a light-coloured EPDM which offers strong shock absorption whilst also ensuring that some of the heat issue is realised. This is yet to be tested in Australia in significant amounts.

- **Rubber Infill Migration**

Rubber infill does have a tendency of migration, especially where the players constantly use the same area, such as with repetitive drills, penalty taking and the main back-bone up and down the centre of a field. To reduce the migration or infill and the level of maintenance; tape systems encapsulate the infill, reduce ball bounce and migration compared to monofilament and should be considered or a combination of monofilament and tape.

- **Amount of Infill**

The amount of infill used in a field will depend on how the manufacturers systems work and against what sports performance standards are chosen. If a shockpad is used, then for the same football codes the yarn length may be as little as 43mm. In Europe, the mix of silica sand and EPDM is being used with a yarn of 43mm allowing 21mm for the fibre to be left above the infill with an infill level of around 22mm.

The important considerations are mix of infill, weight per square meter and the thickness of the yarn fibres to allow the yarn to stay upright. Our recommendation is that if the field is an open field (i.e. not a stadium) then the minimum height of yarn should be 50mm.

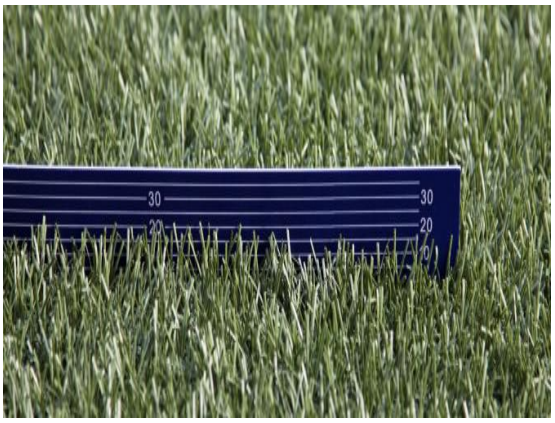


Photo 27: EPDM (Virgin Rubber) Infill allowing around 20mm of grass above the infill

By having a shockpad, there is less need for an extra-long pile field (65-70mm) which removes the level of infill needed by 50% according to FIFA[26]. This will also have a significant impact on the recycling of the infill at the end of life.

- **Safety of Infill**

There has been community discussion around the environmental and health and safety impact of some infills, which is covered later. We would recommend that to provide community comfort the rubbers used are virgin rubbers and have been assessed to EN71.3 (Table 2 Category III) which is Europe's Safety Standard for Toy Ingestion.

There is a move to adopt virgin rubber, so as to move away from the recycled infills, which are the most economical option. The virgin rubbers predominantly add an additional 8-10% to the field project costs.

[26] Environmental Impact Study on Artificial Football Turf (Environmental Research and Consulting for FIFA: March 2017)

Europe had new standards (2020) which are aligned with the level of acceptable of the eight most dangerous PAH's. All infill in Australia should have certification that they can achieve this level. Rugby League in the UK (and soon in Australia) are the first body to adopt this new standard.

The synthetic turf carpet needs to comply with the requirements of the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulations XVII Entry 50. The infill placed within the synthetic turf carpet should comply with the draft REACH restriction requirements of the European Chemical Agency (≤ 20mg/kg of the REACH 8-PAH's).

3.4. Shockpad

3.4.1. Shockpad Considerations

The shockpad is an elasticated layer (E-layer) between the pavement base and the synthetic grass carpet. It is used by many suppliers to provide a degree of comfort, meet the sports' requirements for critical fall height and extend the life of the pitch.

The types and thickness of shockpads need to be considered as part of the overall synthetic surface system to ensure that the important requirements of international sports standards, regarding shock absorption, energy restitution and vertical deformation are met. These requirements may not be met with the compaction of rubber infill.

There has been much consideration and numerous opinions and sales propositions put forward as to whether a shockpad for a synthetic grass field for football (soccer, rugby and AFL) is needed. Many experts believe that if the pitch is played on intensively it is unlikely the playing characteristics will meet the sports performance standards over time if there is not a shockpad in place. Due to the youthfulness of the FIFA Quality Concept and the level of re-testing that has been completed on pitches, it is hard to ascertain with much certainty the impact of not having a shockpad. The belief of the majority of Australian suppliers is that a shockpad is critical in the long-term to achieve performance standards. Over the next couple of years, it will be interesting to explore how many FIFA Quality pitches have a shockpad that are re-tested and achieve the performance criteria, after three and six years.

In September 2014, the European Synthetic Turf Organisation (ESTO) which represents the majority of turf manufacturers, produced an information sheet with the following conclusion:

- "When a Football Turf (World name for synthetic football field) system is regularly and adequately maintained all systems (with and without shockpad) did retain an acceptable level of performance; and
- Within the range of tested samples, we see that the systems containing a high-quality shockpad were likely to show less deterioration than the system without a shockpad in cases where the maintenance was not done correctly."[27]

The question, therefore, is what needs to be considered when deciding on the type of shockpad, especially if the client feels less confident that they will be able to meet the exact routine maintenance obligations?

There are systems that have longer yarn and a denser rubber infill that provide an excellent case for why a shockpad is not needed. The considerations for when a shockpad is believed to be more important is when:

- The field is being used for high contact sports (e.g. Rugby and AFL)
- There may not be adequate maintenance (recommendation is 1 hour per 10 hours of usage)
- There is going to be intense use with flat soled shoes
- The sport stipulates that it is needed (e.g. Rugby Union)

3.4.2. Types of Shockpad

The type and thickness of shockpads needs to be considered as part of the overall synthetic surface system. This is to ensure that the important requirements of international sports standards regarding shock absorption, energy restitution and vertical deformation are met.

There are a range of shockpads offered as part of sports turf systems to the market of varying quality which need to be carefully considered. The most important aspect of the shockpad is its ability to help the overall system meet its performance standards over time, not just the first carpet.

[27] Press Release – European Synthetic Turf Organisations Recommend Shockpads for Synthetic Sports Fields, 2014

It is recommended that the shockpad be reused and therefore needs to be able to cope with the level of usage that the field will endure. This will be addressed in the warranty offered. The two considerations of the warranty should be the life expectancy and the usage parameters. The parameters must be fit for purpose, as its no use having a 20 plus year warranty if that only covers 2,000 hours annual usage (38.5 hours a week) if the field will average 60 hours a week.

There are two kinds of shockpads:

i.) Pre-fabricated construction

There are many systems on the market, including roll-out pads, normally up to 10m in width, prefabricated sheets which once laid out can reduce the time of installation. The latest approach to the preformed shockpads is to allow for breathing in the pad for when they expand and contract.

Some shockpads are currently being developed with breathable channels which allow water through easier and trap air, making them cooler (according to the marketing literature). Tests are being held to ascertain the reality of this process. The challenge with these options is that it may reduce the integrity of the shockpad over time and secondly the channels may not be broad enough to cater for a specific rain event (e.g. 1 = 20 years etc.).

Photo 28: Prefabricated Shockpad being laid (source: Team Sports)

ii.) In-situ construction

This surface infill mix comes in a variation of thickness between 35mm and 10mm and consists of a polyurethane binder mixer combined with rubber crumb (SBR) or shredded rubber (e.g. soles of training shoes). The mix needs to be perfected with the infill for the system to be optimised.

World Rugby have stated in their performance standards that "shockpads are preferred'' and at a conference in New Zealand[28] said they would recommend a shockpad is used for their fields every time.

Loughborough University http://sportsurf.lboro.ac.uk identified that the binder (glue) percentage strength should ideally be between 12 percent and 16 percent when laying shockpads.

Photo 29: Insitu shockpad being laid (source: Polytan)

It is likely to conclude what industry experts have been saying for some time; that if a synthetic system does not have a shockpad, the level of maintenance needs to be higher and more consistent. The shockpad is providing more certainty of achieving the performance targets over time, particularly with the higher level of use.

3.4.3. Reuse of Shockpads

If a shockpad is to be reused, which should be expected for at least two further changes of the carpet, as the majority of shockpads now offer a 20 plus year warranty, the pad needs to be able to demonstrate key performance characteristics. According to the FIFA Quality Manual (2015) it needs to be able to show:

- The shock absorption of the existing shockpad is between 90% and 110% of the shock absorption value declared by the manufacturer when the Football Turf system was initially type approved;
- The deformation of the existing shockpad is +2mm of the deformation declared by the manufacturer when the Football Turf system was initially type approved;
- The water permeability of the shockpad is greater than 180mm/h when tested in accordance with EN 12616.

[28] NZRA Turf Conference (June 2013)

The shockpad must also be able to meet the following additional requirements (source: RFL Guide to the Use of Synthetic Turf Pitches for Competition and Training – 2020 Edition page 31).

Shockpads and Elastic Layers					
Tensile Strength	Shockpads and elastic layers less than 25mm thick	En12230	Unaged	≥ 0.15MPa	
				% loss in strength compared to unaged result	≤ 25%
	Shockpads and elastic layers 25mm or thicker	FIH Hockey Turf and field standards Part 3 clause 8.A.1.2	Unaged	≥ 0.10 MPa	
			After air ageing	% loss in strength compared to unaged result	≤ 25%
	Shockpads with channels and slots	FIH Hockey Turf and Field standards Part 3 clause 8.17.13	Unaged	≥ 0.10 MPa	
			After air ageing	% loss in strength compared to unaged results	≤ 25%

This is a new standard for Australia and should be included in all specifications for all football codes.

3.5. Civil Engineering Solution

3.5.1. Pavement

It is critical to ensure that the sub-base and pavement is designed by a civil engineering specialist so that it can support the synthetic surface system. The design should be based against data from the locations/field inspections including topographical survey, geotechnical report, environmental analysis, drainage study, etc., which needs to be completed by a qualified specialists.

The focus of the sub-base and pavement base design must be able to achieve the following:

- Support the vehicle load during the construction, maintenance and replacement phases;
- Integrate with the synthetic surface to ensure that the sports' performance criteria are achieved;
- Support the load on the pitch once in use, including players and maintenance machinery, to ensure no negative deformation of the surface; and
- Protect the surface from other sub-grade movement or water.

There should be an appropriately deep bore for each of the light towers in addition to the field analysis which typically would be between 8 and 12 bore holes.

3.5.2. Drainage Solution

Drainage is critical to the success of a synthetic sports field and many key aspects need to be considered before deciding which approach to take, namely a vertical or horizontal solution. The following conditions need to be explored prior to purchase as they could make a significant impact on the design and therefore the cost and success of the system.

3.5.3. Sports Guidance

All key grass sports stipulate that water must drain through the surface initially. This means that the water cannot drain horizontally 'on top' of the field, thus avoiding the pooling of water. Each sport has different performance standards, with regards to the permeability of the system that the turf needs to be able to demonstrate. Smart Connection Consultancy recommend 500ml per hour porosity based on the World Rugby Standards.

3.5.4. Site Conditions

The site may influence the type of drainage used. If it is being laid on a concrete base, vertical drainage may not be an option, indeed if the soil base is contaminated, it could be better to use a horizontal drainage solution.

A 'storm rate' needs to be calculated, using the statistics for a 10, 20, 30, 50 or 100-year rain period from the weather bureau in each state/territory to identify a projected hourly rainfall. The drainage needs to be able to cope, retain and or discharge at least this level of rain, particularly if it is higher than the standard for that sport. The drainage strategy needs to be able to capture that level of water, then there needs to be capacity to discharge it to a storm-water point. If it cannot be discharged, then a detention strategy is needed.

- **Flow Conditions**

The flow through the base material or drainage cell and the associated pipe work needs to be able to meet the permeability requirements of either the sports standards and/or the site conditions. Careful evaluation is needed of the drainage approach, normally by a consultant engineer.

- **Vertical Drainage Option**

Traditionally vertical draining utilised the 'AG-drain' strategy which needed to cut through the pavement or sub-base (and which over time), showed loss of integrity to the pavement base for 3G fields.

A more sophisticated approach utilising different sized aggregate stones was introduced by Turf One into Australia and now has been embraced by the market. The void space between the stones (≤ 40%) allows the water under gravity to seep through the stones vertically to collector drains before being taken away.

This is an excellent option to detain the water on site before being connected to the storm-water outlet.

- **Horizontal Drainage Option**

A horizontal drainage option is becoming more popular for synthetic sports turf where the pavement is compacted, and the storm water pipe can handle the quantity of water leaving the field of play, as opposed to a slower release in an aggregate vertical draining base.

Photo 30: Example of horizontal drainage cell under shockpad (source: Wayne Stuart - City of Swan, WA)

The water permeates through the turf/shockpad system either through a drainage cell or by using the drainage channels in a shockpad. Alternatively, the road base can be designed on an angle, so the water can dissipate to drainage around the outside of the field before being taken away.

3.6. Playing Capacity

The playing capacity of a typical community based durable synthetic sports field is between 50 and 80+ hours per week. The number of hours of play is linked to the level of maintenance. It is recommended that one hour of maintenance is considered for every 10 hours of play, depending on the intensity of use for each hour.

If the field will be used intensively and more than 50 hours per week, it is worth ensuring that the durability of the Lisport Test is more than the 20,200 requested by FIFA Quality Recommended Pitches. We recommend at least 80,200 cycles. Some quality yarn systems can cope with 200,000+ cycles on this test.

The usage strategy can vary from 20 hours for a traditional stadium up to more than 70 hours per week for a comprehensively programmed facility. The options may include:

- **Stadium usage**

Low use, around 20 hours per week for training a couple of hours per day and matches at the weekend. In this case a FIFA Quality PRO, FIH Global, RFL Stadium standard pitch could be used.

- **Club (medium) usage**

Medium use, around 30 hours per week and used for training (four hours per day) and weekend matches (five hours each day). The usage would indicate a higher durability need than the one identified in the FIFA Quality PRO Standard of 5,200 to 20,200 reps (FIFA Quality Manual: 2012 Lisport Test).

- **Club/mixed (high) usage**

Integrating weekday, evening times and weekend usage for matches allows organisations such as schools and community groups use - approximately 40 hours' usage.

- **Mixed (intense) usage**

Starting around 50 hours per week, requires greater durability with usage being opened to coaching sessions, club use and matches. Normally this diversity of use is programmed by the owner to ensure transparency and a rigour in the allocation of times.

- **Intense program**

Programming daily (7 hours plus) including weekend games. Many organisations may have usage that includes schools (at a nominal fee), lunch time recreational competitions, coaching sessions, club training and social competitions on weekdays, and matches on a weekend. Typically, a 60-hour week

- **Comprehensive program**

Developing the previous category to around 70 hours or above. There needs to be an enough time built into the program for maintenance at this level.

3.7. Opportunities and Recommendations

The following opportunities and recommendations are made:

i.) The decision-making process on the priorities of which sport and fields should be used for synthetic sports surface technology should be holistic to achieve the needs of the whole Local Government Area or sport across a wide geographical zone.
- The discussion points should be monitored annually to identify if circumstances have changed.
- A three-year review should assess priorities against playing capacity/condition of each field, standards of play needed; economic conditions, growth of participation and strategic alignment.
- The type of synthetic surface technology should be aligned with the needs of the sport, the durability /sustainability and technology available at the time.

ii.) Where possible, multi-sports fields should be adopted to allow maximum community usage.
- Where possible Football (all codes) should be considered for any future design unless there is so much usage in one venue that it would only warrant a single sport.
- Design fields for Football (Soccer) where the field can encourage match, training and recreational needs by including lines for half; quarter and 5-a-side Football pitches.
- The standards for the football codes to meet the durability needed for the intensity of play in Australia include:
  - Football – FIFA Quality
  - Rugby Union – World Rugby Regulation 22
  - Australian Rules – AFL/Cricket Australia Community Facility standard
  - Rugby League – NRL Community Surface standard
  - Hockey – FIH National standard / FIH Multi-sport standard

iii.) Utilize the natural turf/hybrid turf technology for higher wear areas of key fields to allow all fields to be used for up to 30 hrs per week.
- Explore the various Hybrid/Root reinforced systems for the identified fields.
- Develop a three-year strategy for adoption of hybrid/root reinforced technology to assist with the development of the fields to cope with continued demand.
- Conduct an EoI process with current and new companies who are looking to enter into the market to maximise the interest and minimise cost to Council or sport.

iv.) Develop fields that are environmentally friendly.
- When procuring synthetic turf where possible, request premium infill that will negate the negative perceptions around recycled SBR tyres.
- Ensure that the infill has been tested against the ‘toy ingestion standard’ EN71-03 Table 2 Category III.
- Encourage heat reduction technology to be part of the scoping strategy for the procurement of a synthetic system.
- If the infill is recycled car tyres, ensure that the batch of rubber used have been tested to REACH standards.

4. Acrylic and Rubber Surfaces

4.1. Rubber Surfaces

Athletics was an early adopter of synthetic technology and in 1968 athletics installed its first synthetic athletics track for the Mexico Olympics. The times and performances were so impressive that the sport's governing body has never returned to natural surfaces, supporting the technology in order to continue to improve performances.

Photo 31: 1968 Olympic Games Synthetic Track – Mexico

4.2. Types of Rubber Surface

There currently exists a range of synthetic surface systems for athletics facilities approved for use by the IAAF. In Australia, the most commonly used systems are:

- In-situ resin bound rubber crumb system ('structural spray') system
- In-situ composite ('sandwich') system
- In-situ cast elastomer ('full PUR') surface
- Prefabricated sheet synthetic surface

4.2.1. In-situ Resin Bound Rubber Crumb System

The resin bound rubber crumb ('structural spray') system consists of a primary layer of coarse rubber crumb, which is then coated with two coats of a coloured polyurethane paint.

The key benefit of this system is the low cost. It is also a permeable surface which will conceal some unevenness and prevent some ponding by allowing surface water to drain into the pavement.

Photo 32: Application of spray coat

The manufacture of this product requires the use of raw materials for the upper layer, but the base layer is made from recycled rubber.

The advantages of this system are:

- Low cost
- Permeable surface which will conceal some unevenness

The disadvantages of this system are:

- Least durable due to very thin wearing course (i.e. will require respraying more frequently)
- Performance is inferior to other option
- Requires still conditions during installation for consistent application
- Any adjacent structures will need to be protected to avoid from spray

4.2.2. In-situ Composite System

The composite ('sandwich') system is a hybrid system designed to achieve similar performance to the full polyurethane ('full PUR') system at a lower cost. A base layer of coarse rubber crumb is laid on site and a solid elastomer layer is then cast on top. The surface is also finished with EPDM rubber broadcast across the surface to provide the textured finish.

The surface is indistinguishable from the 'full PUR' surface and performance is similar. It is less expensive than the 'full PUR', however, due to the use of cheaper coarse rubber in the base course.

Photo 33: Application of wearing layer over rubber base mat

Compared with 'full PUR', durability is slightly lower and force reduction and vertical deformation tends to be slightly higher (i.e. softer).

The advantages of this system are:

- Economic alternative to the full depth cast surface because of its identical appearance and similar performance characteristics

The disadvantages of this system are:

- System is typically not considered for elite track facilities

4.2.3. In-situ Cast Elastomer System

Cast elastomer ('Full PUR') surfaces are poured on site as a free-flowing liquid to form a full depth of solid cast polyurethane rubber. Coloured EPDM (ethylene propylene diene monomer) rubber is then broadcast across the surface for the final finish.

The advantages of this system are:

- High strength and durability
- Good performance characteristics

The disadvantages of this system are:

- High cost due to thickness of cast polyurethane layer
- If incorrectly installed can lose the 'cushion' feel underfoot

4.2.4. Prefabricated Sheet Synthetic Surface

Prefabricated sheet surfaces are constructed by manufacturing rolls of rubber surface in a factory and bonding it to an asphalt base on site using adhesive. It is commonly the preferred system for high performance competitions.

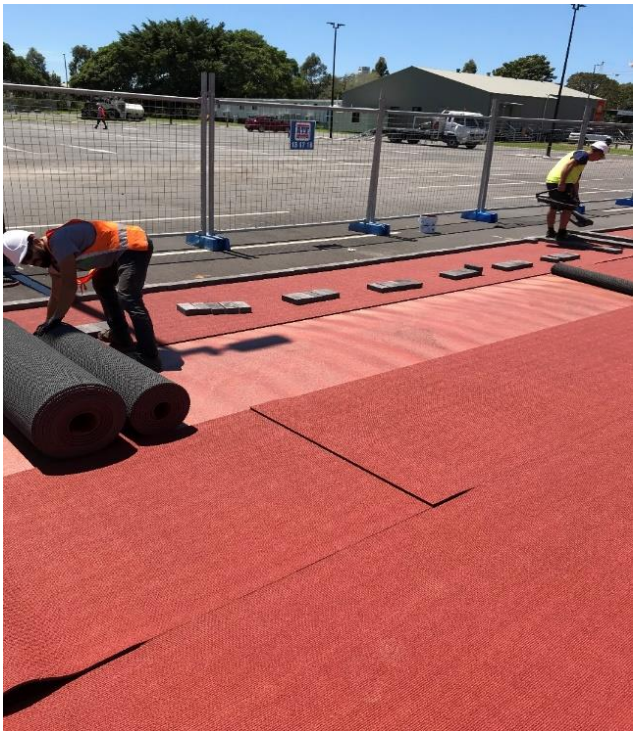


Photo 34: Rolling-out prefabricated synthetic surface

The advantages of this system are:

- Consistent adherence to performance requirements such as force reduction, friction, thickness and colour due to manufacturing in a controlled environment

The disadvantages of this system are:

- Any imperfections in evenness and slope of the base will be replicated on the surface, therefore requiring tighter construction tolerances.
- High degree of skill required to achieve smooth joints and a good bond with the base.
- Installation of this type of system involves the use of weather-sensitive adhesives.

4.3. Maintenance

Athletics track synthetic surfaces require regular maintenance to achieve an on-going high standard surface. Timing of replacing high wear areas is also important to consider and factor into relevant budgets.

The following maintenance procedures are recommended on all track surface types to ensure the longevity and performance of the surface:

- Removal of debris from the surface (rubbish, organic matter, sand from landing pits)
- Treatment of weeds, algae and moss with approved chemicals then removal using pressure washing
- Checking the surface is securely fastened to the base
- Checking of all lines and marks, renewing when needed
- Major cleaning, carried out twice per year, using high pressure water-cleaning
- Replacement of high wear areas/ worn out areas as required

All maintenance practices should be verified by the surface manufacturer/ installer.

4.4. Expected Life Cycle

The lifecycle of an athletics track surface is heavily dependent on the following:

- Level of use
- Level of maintenance
- Standard of initial construction
- Environmental factors (e.g. UV exposure)

The following table provides an overview of the expected life cycle for an acrylic surface:

Year	Activity
0	Pavement constructed Athletics track surface system installed
3 – 5	Repair high-wear areas
7	End of warranty period
10 – 15	Grind profile and apply 'wearing surface'
20+	Full resurface

Costs

Depending on exchange rates, the following table outlines typical costs for the above systems.

Athletics Track System	Rate(/m^2)
In-situ Resin Bound Rubber Crumb System	$40 – 45
In-situ Composite System	$65 – 70
In-situ Cast Elastomer System	$90 – 95
Prefabricated Sheet Synthetic Surface	$110-120

4.5. Hard Court – Tennis and Netball

Currently within the Australian market there is a wide selection of manufacturers and installers of acrylic products. Generally, the final outcome of an acrylic system will be highly dependent of the skills of the installer, rather than the product itself.

The intention of this Guide is to provide guidance on the various acrylic systems on the market for tennis and netball facilities, including maintenance and expected life cycles for the surface.

Acrylic surfaces are popular playing surface options for both tennis and netball facilities across Australia.

4.5.1. Standards and Requirements

The governing bodies for both sports provide guidance on surface selection.

Photo 35: Testing apparatus for slip resistance

Netball Australia assess the performance of courts based on slip resistant properties of the surface. There are two tests used to determine the slip resistance of an acrylic surface for netball court:

- Initial Construction Test – AS/NZS 4586: 2004 Slip Resistance Classification of New Pedestrian Surface materials – British Pendulum Number for wet slip resistance testing of not less than 75
- Re-testing – AS/ NZS 4633: 2004 Slip Resistance Classification of Existing Pedestrian Surface Materials - British Pendulum Number for wet slip resistance testing of not less than 75

The International Tennis Federation (ITF) have developed a Court Pace Classification system to assist in determining speed and type of surface that is most suited for a facility. ITF classified surfaces do not imply any form of approval for the products.

For multi-use facilities (e.g. Netball and Tennis) it is important to consider the dominant sports when selecting the acrylic system to be installed. Netball surfaces typically contain a high content of sand to create surface with more grip to enable wet weather play.

4.5.2. Systems

An acrylic surfaced court requires the application of multiple layers of acrylic materials on an asphalt or concrete pavement. There are 4 main types of acrylic surfacing systems available in Australia:

- Multi-layered acrylic system
- Liquid Applied cushioned acrylic system
- Prefabricated system
- Gel system

The type of acrylic system selected should consider the following:

- Project budget
- Level and type of use for the facility (e.g. will the facility host tournaments)
- Local environmental and weather conditions
- Site conditions (e.g. reactive soil conditions)
- On-going maintenance requirements and associated costs
- Replacement costs
- User preferences

Multi-Layered Acrylic System

A multi-layered acrylic system comprises of 3-4 layers of filler and topcoat applied directly to the underlying pavement.

The advantages of this system are:

- Affordable option with comparable playing characteristics to other acrylic surfaces
- Lower resurfacing costs

The disadvantages of this system are:

- Does not provide any shock absorption to users
- Acrylic surface will crack with any cracking or movement of the underlying pavement
- Application timeframe is restricted to warmer months

Liquid Applied Cushioned Acrylic System

- A liquid applied cushioned acrylic system comprises of 8-12 layers of base, rubber filled resin and topcoat. This system provides a level of shock absorption through the rubber layers applied within the system.

Photo 36: Application of acrylic system

The advantages of this system are:

- System provides a level of cushioning for users

The disadvantages of this system are:

- Application timeframe is restricted to warmer months
- Rubber cushioning may require topping up when resurfacing occurs

Prefabricated Acrylic System

Prefabricated (mat laid) acrylic systems consist of manufactured rolls of a rubber surface bonded to an asphalt or concrete pavement. A liquid applied acrylic product is then applied over the prefabricated mat.

The advantages of this system are:

- Can provide a bridge over moving/ cracked pavements
- More consistent performance due to manufacturing in a controlled environment

The disadvantages of this system are:

- Initial construction/ repair of worn areas/ resurfacing can be expensive

Photo 37: Installation of prefabricated mat system

Gel System

Gel systems are relatively new technology providing a cushioned court surface with a self-levelling applied gel layer.

The advantages of this system are:

- Gel layer is self-levelling to provide uniform thickness and ease of application
- Greater force reduction compared with other acrylic systems

The disadvantages of this system are:

- Lifespan in Australian climate is unknown due to limited installations

Photo 38: Application of gel system

4.5.3. Maintenance

Generally, an acrylic surface has lower maintenance requirements than other outdoor surface options for both sports. To ensure the performance and longevity of an acrylic surface, it is recommended that a regular maintenance regime is undertaken and includes:

- Regular removal of debris and foreign matter
- Remove standing water to reduce risk of staining
- Annual high-pressure clean
- Repair of surface cracks to prevent moisture migration under acrylic surface
- Resurfacing of acrylic typically every 7-10 years

4.5.4. Expected Life Cycle

The lifecycle of an acrylic surface is heavily dependent on:

- Level of use
- Level of maintenance
- Standard of initial construction
- Environmental factors (e.g. UV exposure)

The following table provides an overview of the expected life cycle for an acrylic surface:

Year	Activity
0	Pavement constructed Acrylic surface system installed
3 - 5	End of product warranty period
5 - 7	Resurface of acrylic surface
20+	Possible pavement reconstruction/ remedial works

Costs

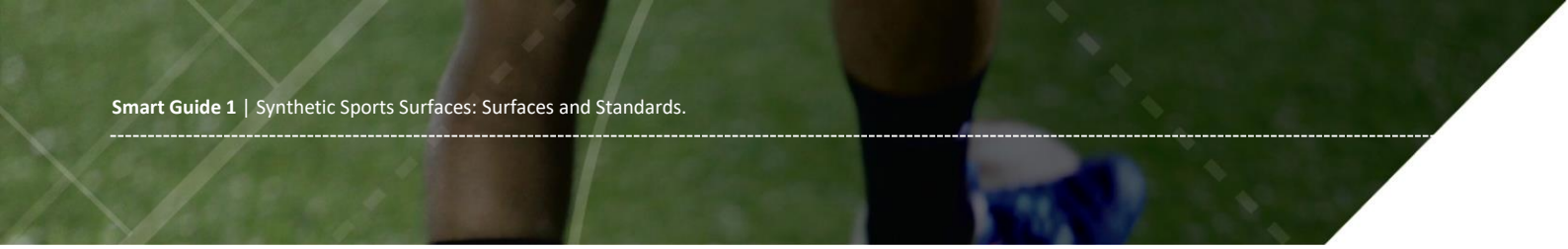
The following table provides an estimate for the typical costs for the above systems.

Acrylic System	Rate (/m²)
Multi-layered acrylic system	$12.50 – $14
Liquid applied cushioned acrylic system	$50
Prefabricated acrylic system	$50 – $70
Gel system	$55

4.6. Conclusion

Rubberised athletic tracks have been used for the past five decades at the highest and community levels. The technology is now being used for jogging tracks around cities, playground areas and inside schools to encourage movement and active play with great success.

Acrylic surfaces provide an excellent durable floor system for playing many sports including netball, tennis, basketball, five-a-side soccer and others. Its durability and lower maintenance allow it to be embraced by sport and active recreation areas including Multi-sport Activity Zones.



5. Key Contacts

5.1. Independent Advisory Services

Smart Connection Consultancy

Martin Sheppard, Managing Director

Suite 40, 204-218 Dryburgh Street

North Melbourne VIC 3051

p: (03) 9421 0133

e: martins@smartconnection.net.au

w: www.smartconnection.net.au

Consultant to all Football Codes in Australia

5.2. Key Sports

Football Federation Australia (Football)

Ricardo Piccioni, Government Relations Manager

Level 22, Oxford Street

Darlinghurst NSW 2010

p: (02) 8020 4021

e: ricrardo.piccioni@ffa.com.au

w: www.ffa.com.au

National Rugby League Limited (NRL)

Luke Ellis, Participation, Pathways and Game Development

Rugby League Central, Driver Avenue

Moore Park NSW 2021

p: (02) 9359 8500

e: lellis@nrl.com.au

w: www.nrl.com

Rugby Australia (RA)

Michael Procajlo, Head of Game Development

Rugby Australia Building

Cnr Moore Park Road and Driver Avenue

Moore Park NSW 2021

p: (02) 8005 5555

e: Michael.Procajlo@rugby.com.au

w: www.rugbyaustralia.com.au

Australian Football League (AFL)

Shayne Ward, Executive Officer, AFL/Cricket Australia Synthetic Turf Program

Australian Football League

National Venues and Community Facilities

AFL House, 140 Harbour Esplanade

Docklands VIC 3008

p: (03) 8341 6085

e: shayne.ward@afl.com.au

w: www.afl.com.au

Gridiron Australia

Darrin Mitchell, Chairman

PO Box 170

Woden ACT 2606

e: info@gridiornaustralia.org.au

w: www.gridironaustralia.org.au

Touch Football Australia

Jamie O'Connor, Chief Executive Officer

Suite 1/18 Napier Close

Deakin ACT 2600

p: (02) 6212 2800

e: jamie.oconnor@touchfootball.com.au

w: www.touchfootball.com.au

Australian Oztag

Bill Harrigan, Chief Executive Officer

PO Box 703

Cronulla NSW 2230

p: (02) 9562 8633

e: info@oztag.com.au

w: www.oztag.com.au

5.3. Suppliers and Agents

ABS Sport Surfaces

3 Cochrane Street

Mitcham VIC 3132

p: (03) 9873 0101

e: daarons@berrysportsurfaces.com.au

w: www.abs-sportsurfaces.com.au

FieldTurf Australia

Unit 8.1, 1A Hale Street, Portair Industrial Estate

Botany NSW 2019

p: (02) 9316 7244

e: info@fieldturf.com.au

w: www.fieldturf.com

- FIFA Preferred Producer
- World Rugby Preferred Provider
- AFL Approved Manufacturer

Grassports Australia

1/38 Green Street

Doveton VIC 3177

p: (03) 9792 0622

e: info@grassports.com.au

w: www.grassports.com.au

Grassports Australia and ABS Sports Surfaces are an agent for Polytan, who are:

- FIFA Preferred Producer
- World Rugby Preferred Provider
- AFL Approved Manufacturer

Greenplay Australia

3/550 Churchill Road

Kilburn SA 5084

p: 1300 769 499

e: as@greenplay.com.au

w: www.greenplay.com.au

Greenplay Australia is an agent for the Limonta products. Limonta are:

- FIFA Preferred Producer
- World Rugby Preferred Provider

HG Sports Turf Australia

Suite 2, Level 1, 526 Whitehorse Road

Mitcham VIC 3132

p: (03) 9329 8154

e: info@hgsportsturf.com.au

w: www.hgsportsturf.com.au

HG Sports Turf is an agent for Desso, recognised as:

- FIFA Preferred Producer
- World Rugby Preferred Provider

Also provide a range of Hybrid solutions for local government, sport and stadia

Polytan

Factory 3, Dunlopillo Drive

Dandenong South VIC 3175

p: (03) 8792 8000

e: enquiry@polytan.com.au

w: www.polytan.com.au

- FIFA Preferred Producer
- World Rugby Preferred Provider
- AFL Approved Manufacturer

Synergy Turf Manufacturing

165 Prospect Highway

Seven Hills NSW 2147

p: 1300 796 100

e: help@synergyturf.com.au

w: www.synergyturf.com.au

Synergy Turf is the agent and Australian manufacturer for Greenfields, recognised as:

- FIFA Preferred Producer
- World Rugby Preferred Provider

TigerTurf Australia

14 Latitude Boulevard

Thomastown VIC 3074

p: 1800 802 570

e: auinfo@tigerturf.com

w: www.tigerturf.com

TigerTurf is a FIFA Licensee

Tuff Group

58-60 Sunmore Close

Heatherton VIC 3202

p: 1800 887 326

e: enquiries@tuffturf.com.au

w: www.tuffturf.com.au

Tuff Turf is an agent for the Co-Creation Grass (CCG) products. CCG is:

- FIFA Preferred Producer
- World Rugby Preferred Provider

Turf One

Unit 12/89 Simcock Avenue

Spotswood VIC 3015

p: (03) 9719 1900

e: info@turfone.com.au

w: www.turfone.com.au

Turf One is an agent for the FieldTurf products. FieldTurf is a:

- FIFA Preferred Producer
- World Rugby Preferred Provider
- AFL Preferred Manufacturer

5.4. Independent Testing Institutes

Acousto-Scan

44/59-69 Halstead Street

South Hurstville NSW 2221

p: (02) 8385 4872

e: admin@acoustoscan.com.au

w: www.acoustoscan.com.au

Labosport Australasia

52 Raby Esplanade

Ormiston QLD 4160

p: (07) 3286 2237

e: keith.mcauliffe@labosport.com

w: www.labosport.com

5.5. Other Useful Contacts

Smart Connection Consultancy

www.smartconnection.net.au

5.5.1. Global Peak Bodies for Synthetic Turf

Synthetic Turf Council (STC, USA)

www.syntheticturfcouncil.org

European Synthetic Turf Organisation (ETSO, Europe)

www.theesto.com

Sports and Play Industry Association (SAPIA, AUS)

www.sapia.org.au

Sports and Play Contractors Association (SAPCA, UK)

http://www.sapca.org.uk/

International Association for Aquatics and Leisure Facilities (IAKS)

https://www.iaks.org/

5.5.2. International Sports Federations

Football/Soccer – FIFA - Quality Program for Football Turf

http://quality.fifa.com/en/About-the-programme/

Rugby Union – World Rugby - Rugby Turf Program

http://playerwelfare.worldrugby.org/rugbyturf

Hockey – International Hockey Federation (FIH)

http://www.fih.ch/

Tennis – International Tennis Federation (ITF)

https://www.itftennis.com/en/

Athletics – World Athletics (WA)

https://www.worldathletics.org/

Photo 39: Blacktown Rugby League Field

Photo 40: Chatswood High School

About Smart Connection Consultancy

Smart Connection Consultancy offers an innovative approach that delivers outcomes to enhance the experience of participation in physical activity, recreation and sport in local communities.

We specialise in the planning, development, management and procurement of synthetic sports surface technology. We see this technology as complementing natural grass and encouraging more people to be active, play and achieve success in sport because of its extended durability.

By embracing the skills sets and knowledge of our collaborative consultants, we can provide an integrated and holistic approach to our client's projects.

Smart Connection Consultancy is the Technical Consultants for FFA, the NRL, and Rugby Australia for Synthetic Surfaces.

Field of Expertise

In collaboration with industry experts, we provide our clients with high level quality service that is offered for a very affordable investment.

Commitment to Knowledge Building

We are committed to providing leading edge advice and knowledge so that the industry and our clients can appreciate how synthetic sports turf can complement their natural turf options.

Our Services Include:

Feasibility and Funding Advice and Solutions

Completing a Business Case to justify the need of a synthetic surface can be streamlined by using our Smart Whole of Life Costing Model. We support clients in developing financial strategies, funding applications and where applicable offer funding packages with major financial institutes.

Masterplanning and Design Solutions

We will work with you in exploring the site parameters and constraints together with the opportunities to ascertain the best design and management options for your park or venue.

Procurement and Project Management Support

Over 20 years' experience in procurement and in collaboration with SPORTENG, we provide the detailed civil engineering hold points to ensure that every step of the installation meets the appropriate civil and performance standards.

Our Clients

We have successfully completed a significant number of sports performance standards reviews, sports strategies, master plans, feasibility studies, business cases and procurement projects. Our client base includes:

- International Federations (FIH, FIFA, World Rugby)
- National and State Sports Organisations including Football Federation Australia (FFA), National Rugby League (NRL), Rugby Australia (RA), Australian Football League (AFL NSW/ACT), Golf Australia, Sport Australia, Hockey ACT etc.)
- Local Governments – More than 100 local governments with fields worth over Aus$200 million, in most States/Territories
- Education – Schools and Universities in WA, NSW, ACT and Victoria

"Over the last four years the relationship the City has built with Smart Connection Consultancy has become integral to the development of our public open space planning, most notably the Ellenbrook District Open Space, which includes four synthetic playing fields.

Smart Connection Consultancy has contributed in many ways including various studies, reports and research tours that we continue to use today. The work has been outstanding: on time, on budget and most importantly of a very high quality.

Martin has been very accommodating in its approach to our requirements and continues to go out of their way to help us where necessary – always going that extra mile."

Wayne Stuart, Facilities Planning Coordinator, Asset Management – City of Swan

Smart Synthetic Sports Field Health Check

Review your field, understand risks and extend life expectancy

Australia's leading synthetic sports surface consultancy is offering the **Smart Synthetic Sports Field Health Check**, for clients who wish to find out what condition their synthetic fields are in and what is the probable life expectancy.

Smart Connection Consultancy has been involved in over 70% of all the synthetic football fields (all codes) developed and installed in Australia in the past decade. We work closely with our clients to maximise their usage and life expectancy of their fields.

The Smart Synthetic Sports Field Health Check consists of:

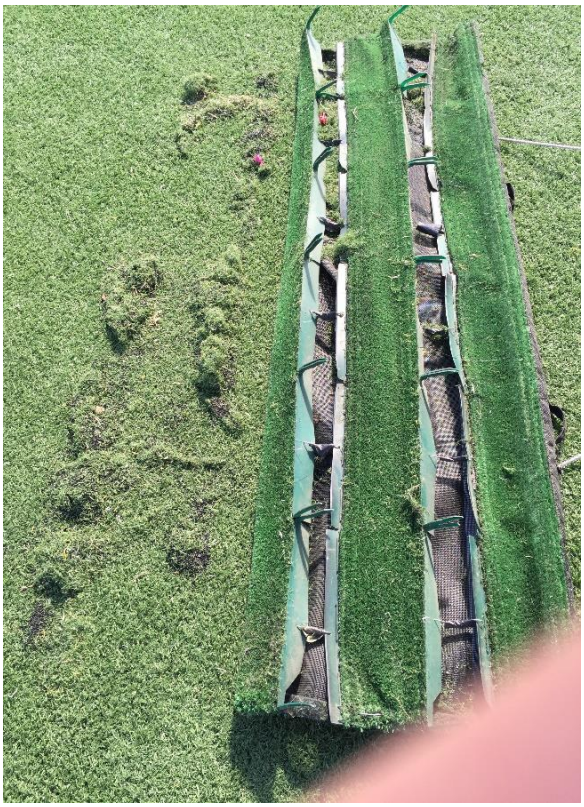
- Conducting a site analysis and field review to ascertain its current status;
- Assessing current maintenance practices to explore if this can extend the life of the field;
- Reporting on findings with improvement strategies;
- Risk assessment with mitigation strategies;
- Predicting life expectancy; and
- Replacement costings and modelling.

An Assessment Report provided within 48 hours of field assessment.

"The Smart Sports Field Health Check allowed us to appreciate the challenges we had, reduce our risks by adopting the risk mitigation strategies identified and we believe that we have extended the expected life by two years by adopting the recommendations for remediation and maintenance."

(Mick Roberts, Sports Grounds Manager, ACT Government)

Call (03) 9421 0133 and talk to Martin Sheppard or email martins@smartconnection.net.au to find out how the Smart Sports Field Health Check can extend the life of your synthetic sports field.



SPORT INSPIRES A NATION

Synthetic Sports Surfaces Create the Opportunities for All Generations

smarter synthetic solutions

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smart connection consultancy

Suite 40, 204-218 Dryburgh Street
North Melbourne VIC 3051

Tel: +61 3 9421 0133
Email: martins@smartconnection.net.au

www.smartconnection.net.au